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THE MAGAZINE OF TECHNOLOGY INTEGRATION

NOVEMBER 1995

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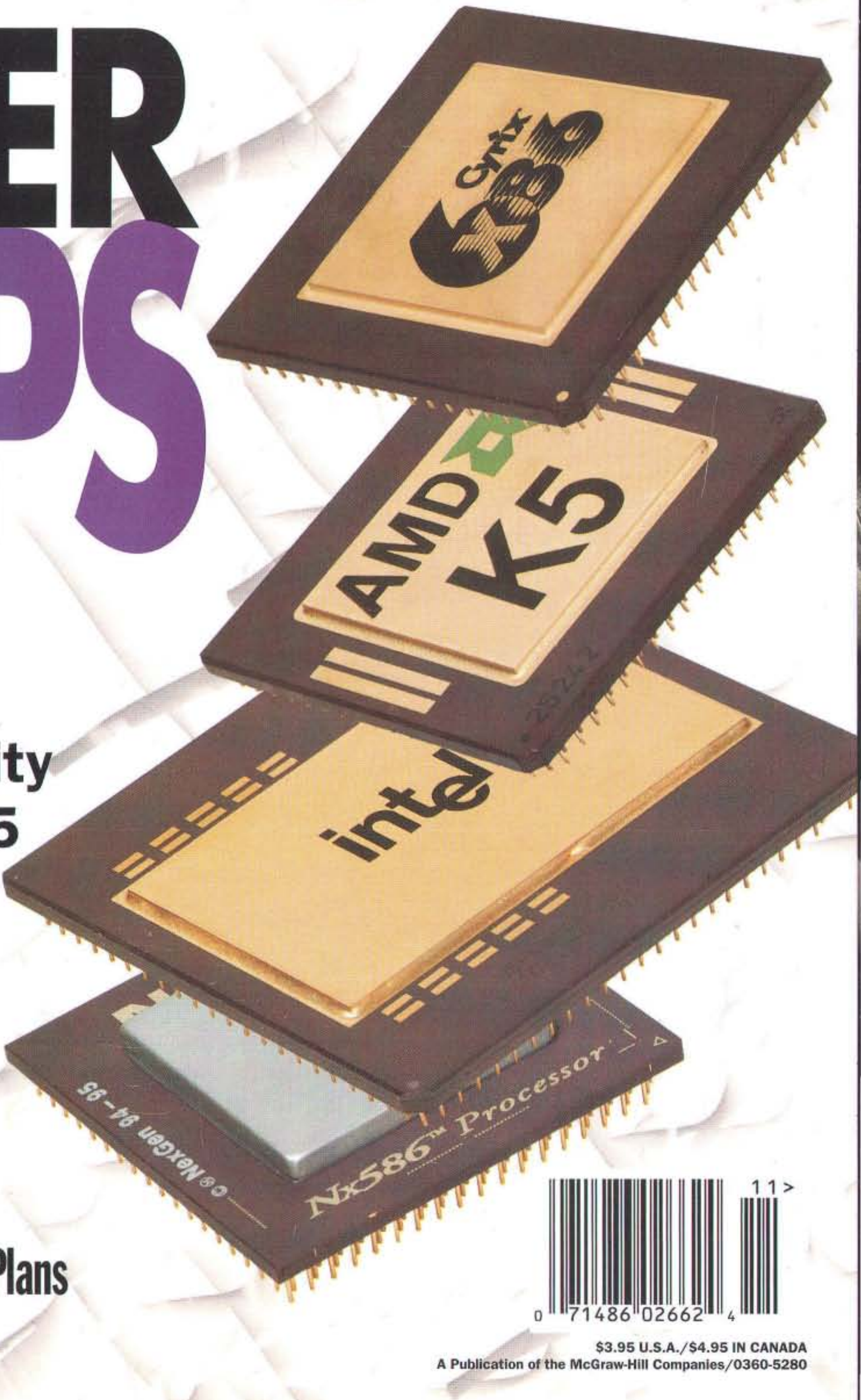

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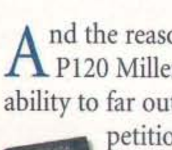

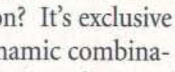

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May 30, 1995
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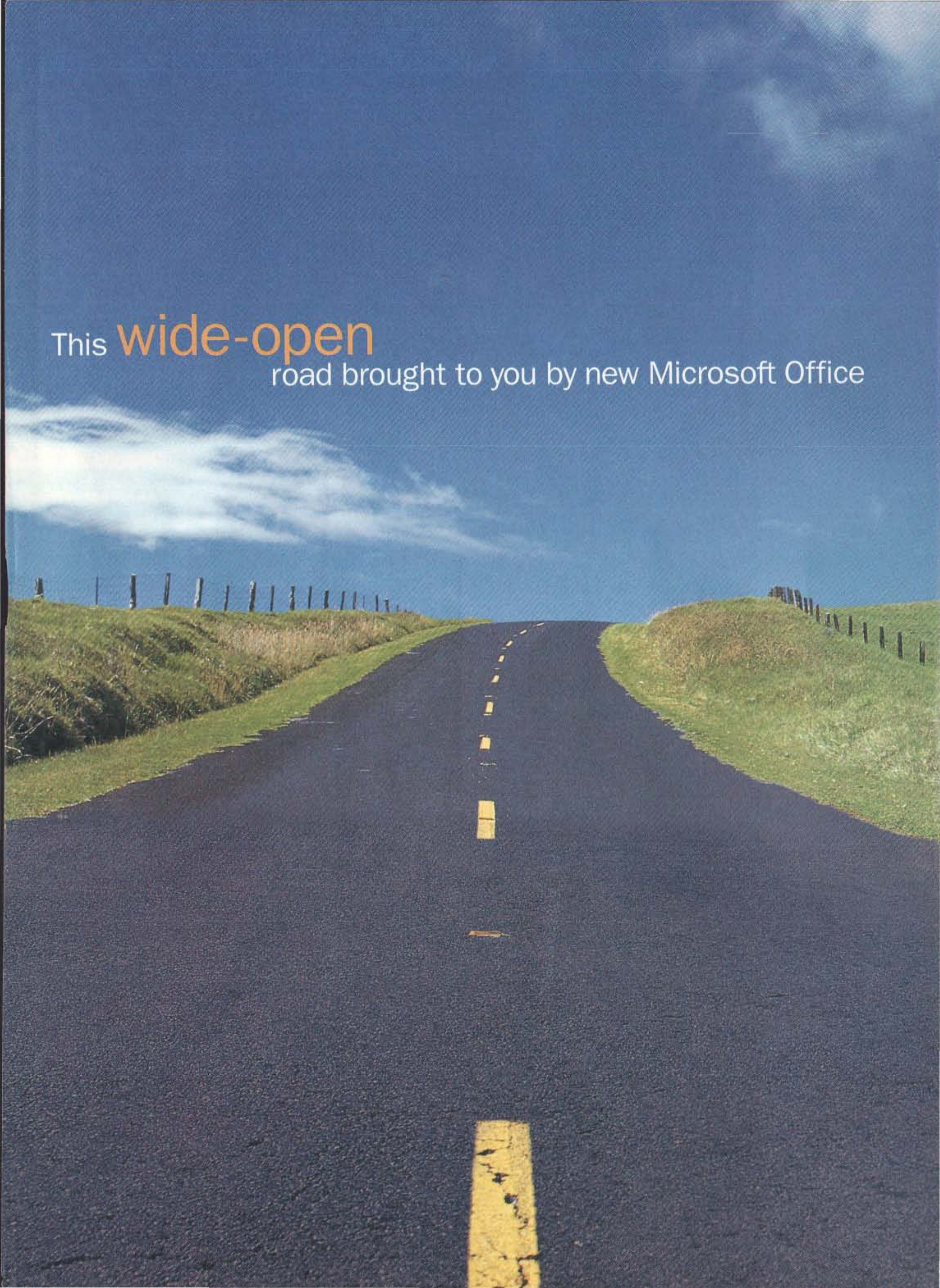
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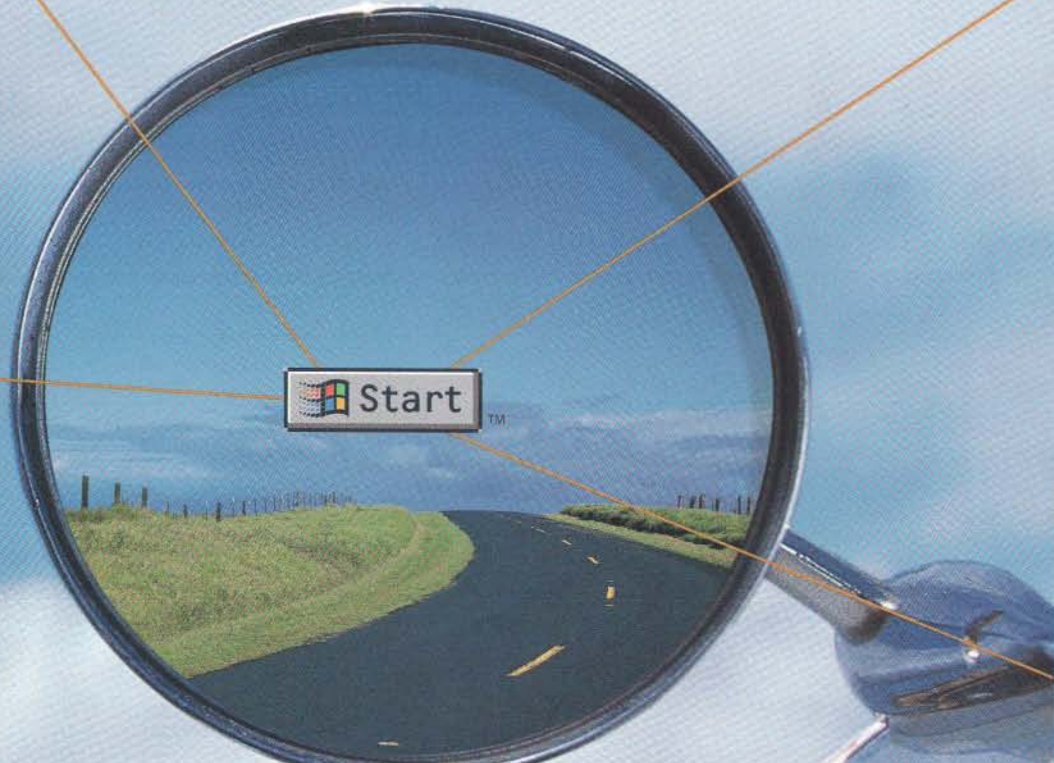

Now you can take full advantage of Windows 95.

New Microsoft Office was designed to work hand-in-hand with the Windows® 95 operating system and its simplified user interface. To make the most of 32-bit performance, long filenames, shortcuts, multitasking, and the Windows Explorer. Together, they make computing fundamentally easier and faster. They make it possible for you to spend less time computing, more time working effectively.

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OO Meets OS 123
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And One for All 131
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Organization Made Loud and Clear 217
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OO Meets OS 123
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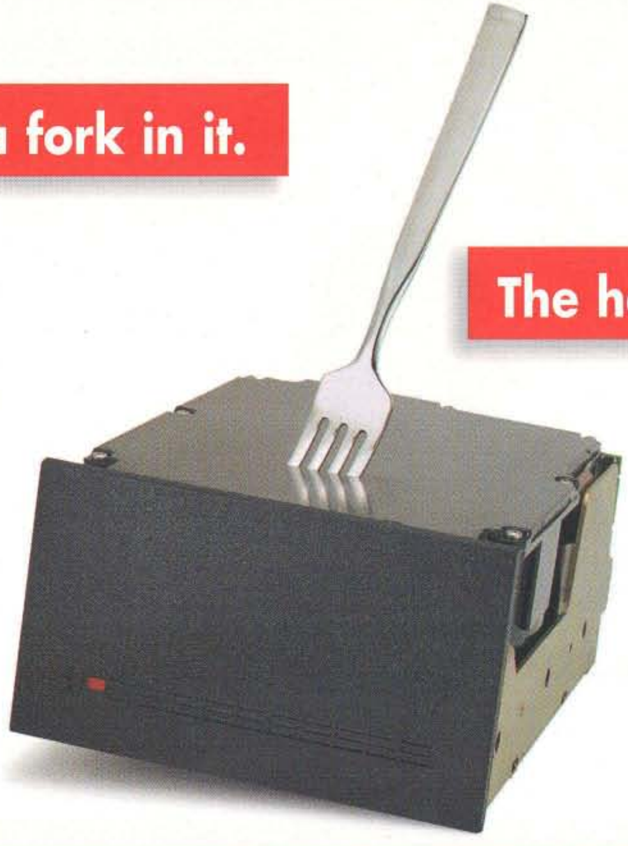
Put a fork in it.



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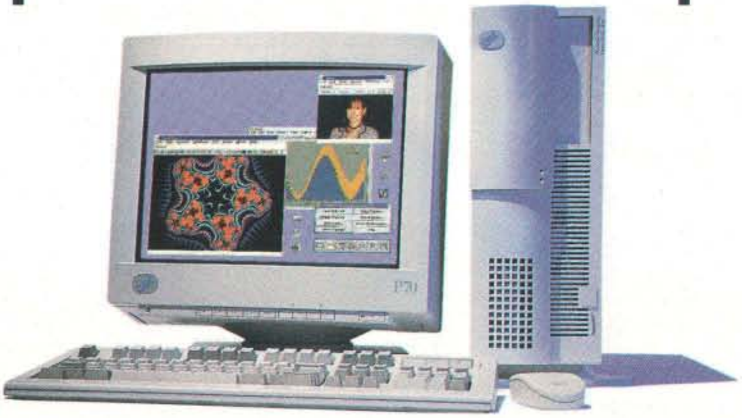

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EDITORIAL **Raphael Needleman**

The Ultimate Operating System?

It takes more than a zillion-dollar marketing budget to build the perfect operating system

I spent August 24 at the beautiful Microsoft campus in Redmond, Washington. The weather was ideal for the launch of Windows 95; the clouds did a perfect imitation of the background graphic on the Windows 95 carton. Five hundred journalists and I gave up our smug attitude for a few hours to sit in the de facto cheering section at an event that reminded many of us more of a fashion show than a computer product launch.

At one point, I had to restrain myself from leaping up in the middle of the hype and screaming, "Listen to me! It's just an OS upgrade! GET A LIFE!" Later, however, I found myself strangely caught up in the act, laughing at Jay Leno's faux-Luddite act and actually applauding when the big tent wall was dropped to reveal the bleachers full of color-coordinated Windows programmers.

It didn't take me long to come to my senses again, fortunately. All the fancy positioning and expensive marketing can't mask the more important question of the Windows 95 release: How will it really impact the way people work? Because it's the product, not the posture, that will ultimately make the difference.

Will Win 95 take the world by storm, bringing a new class of users to technology? Or will the remnants of DOS that remain in the product push people to more carefully consider the Mac, which has had, as Apple is happy to remind us, a Trashcan icon for 10 years already? Or worse, will the Win 95 hoopla and the emasculated Rolling Stones "Start Me Up" commercial (the words "You make a grown man cry" having been removed from the lyrics) backfire on Microsoft the way the nuns-with-beepers ads submarined OS/2?

I have to admit that I like Win 95. I've been using it for several months, and it's pretty good for a major upgrade. But there's a lot of stuff I miss in this OS. I wish I could take the elements I like from all the OSes available and build my own. Component technology doesn't quite offer me that flexibility yet. But if it did, here's what I'd do:

The kernel. Oh please, let me dump this ancient half-DOS system and build something more tight, more cross-platform, more robust. Like Windows NT.

User interface. People think I'm a Windows bigot, but that's just because I like to use a lot of different applications, and Windows has more than anybody else. Actually, I'd trade it in for parts of the Mac OS in a heartbeat. The Mac's user interface is better integrated into the OS itself, more consistent, and easier to teach.

Size. Why do I need 40 MB of hard disk space and 16 MB of RAM for a single-processor, single-user OS? I've seen faster, smaller, and equally graphical OSes that, theoretically, could do everything I need. GeoWorks and QNX come to mind.

Networkability. My OS should be able to easily hop onto and off the Internet, a Novell LAN, and wireless services. I like Win 95's capabilities in this arena, but the Mac and OS/2 also do well here.

Multi-everything. I want flexibility. That means an OS architecture that scales from the address book on my personal digital assistant (PDA) up to a big database server. I want my OS to support multiple processors (which NT and big-iron systems like VMS do). I want it to be multithreaded and multitasking (NT, OS/2, Win 95), so background processes don't bottleneck my whole system. I want it multiuser (Unix), so I can distribute some of my applications without requiring a full-power computer at each seat. Finally, it has to be multiplatform, so I'm not locked into Intel, Motorola, or any other chip architecture.

Object-oriented. Object-oriented OSes (OOOSes; great acronym, isn't it?) make for better data sharing among applications and, thanks to reusable components, easier applications development. This last bit is important because it makes programming less expensive, and when you spend less money on that, you can spend more on testing and reliability. The best OOOS we've seen here is NextStep, although the Newton's OS also scores well.

The ideal OS, of course, doesn't exist. But to see how close we are to OS nirvana, check out our Special Report, which begins on page 73.

And in the meantime, be thankful that there is no perfect OS. It means your job as a technologist is safe, as is mine. For now, at least. ■

RAPHAEL NEEDLEMAN, EDITOR IN CHIEF
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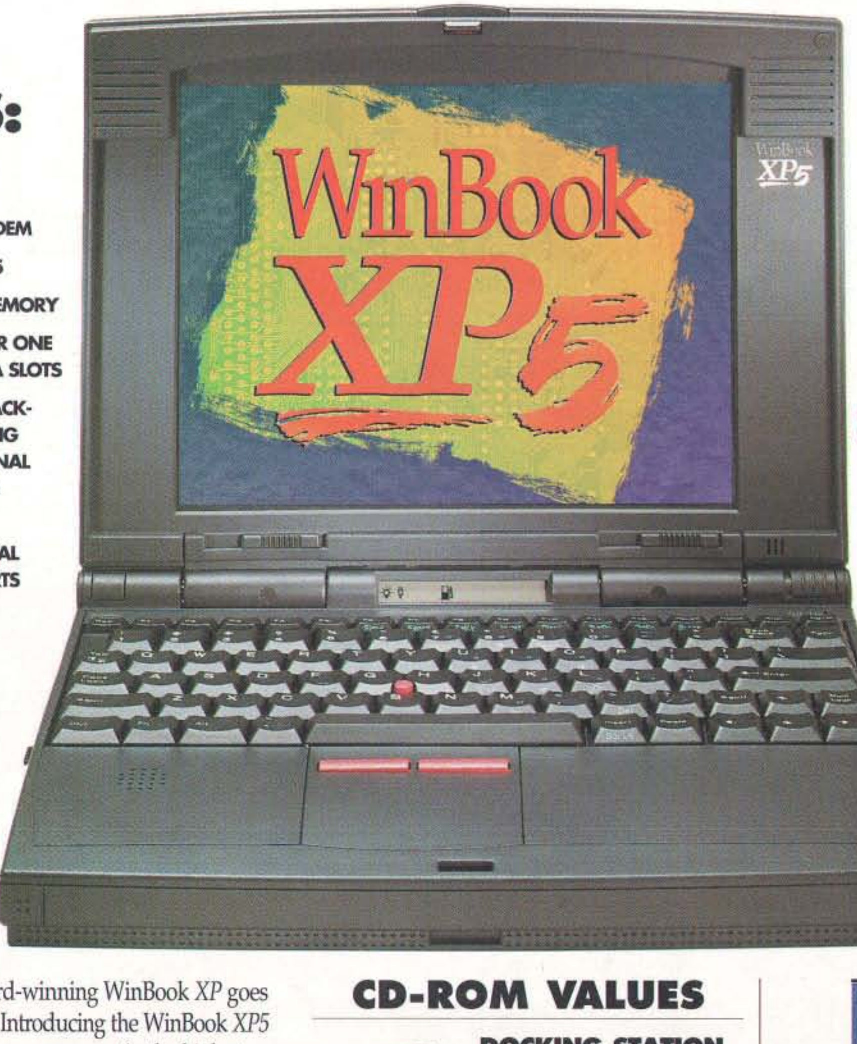

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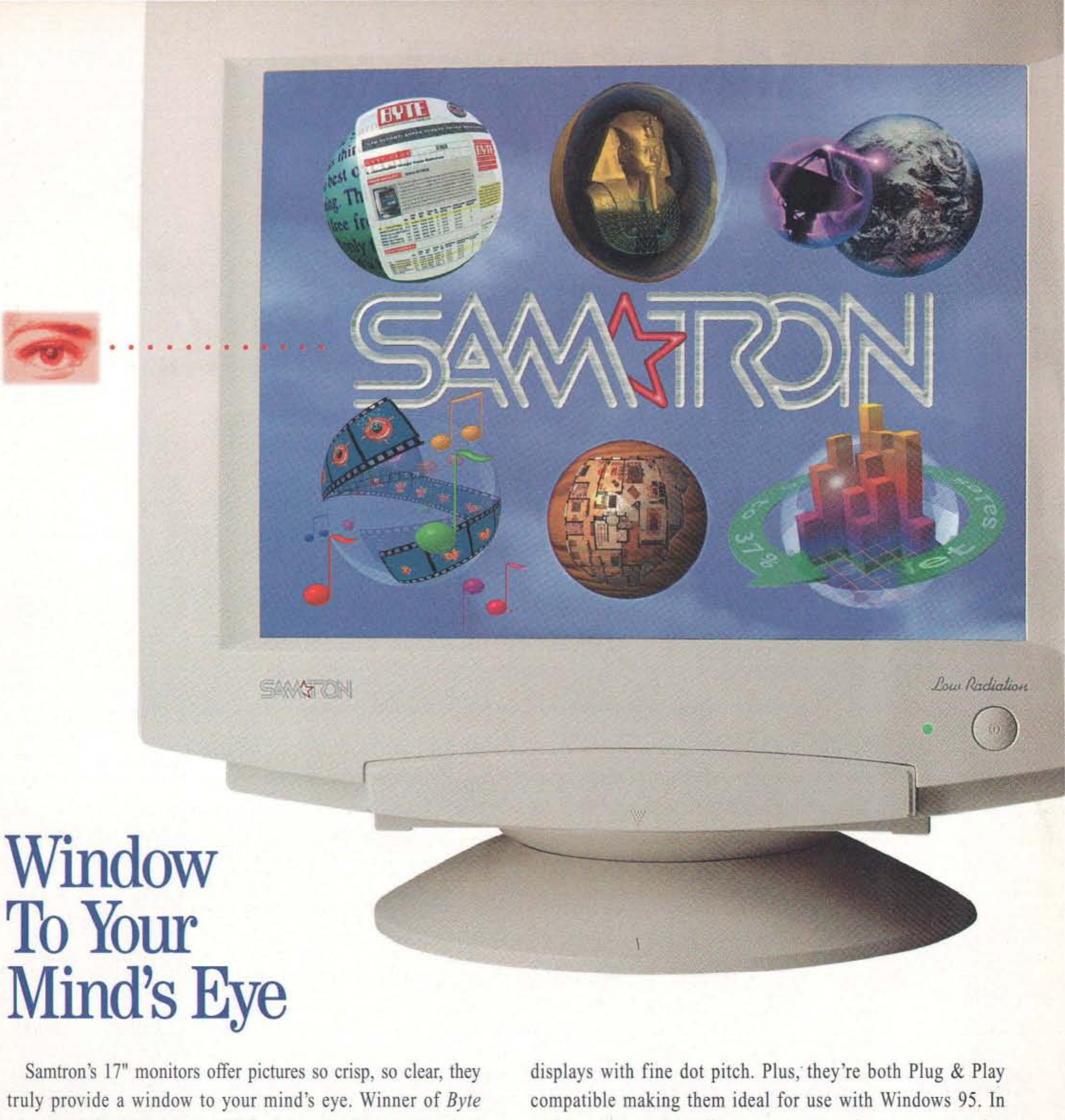

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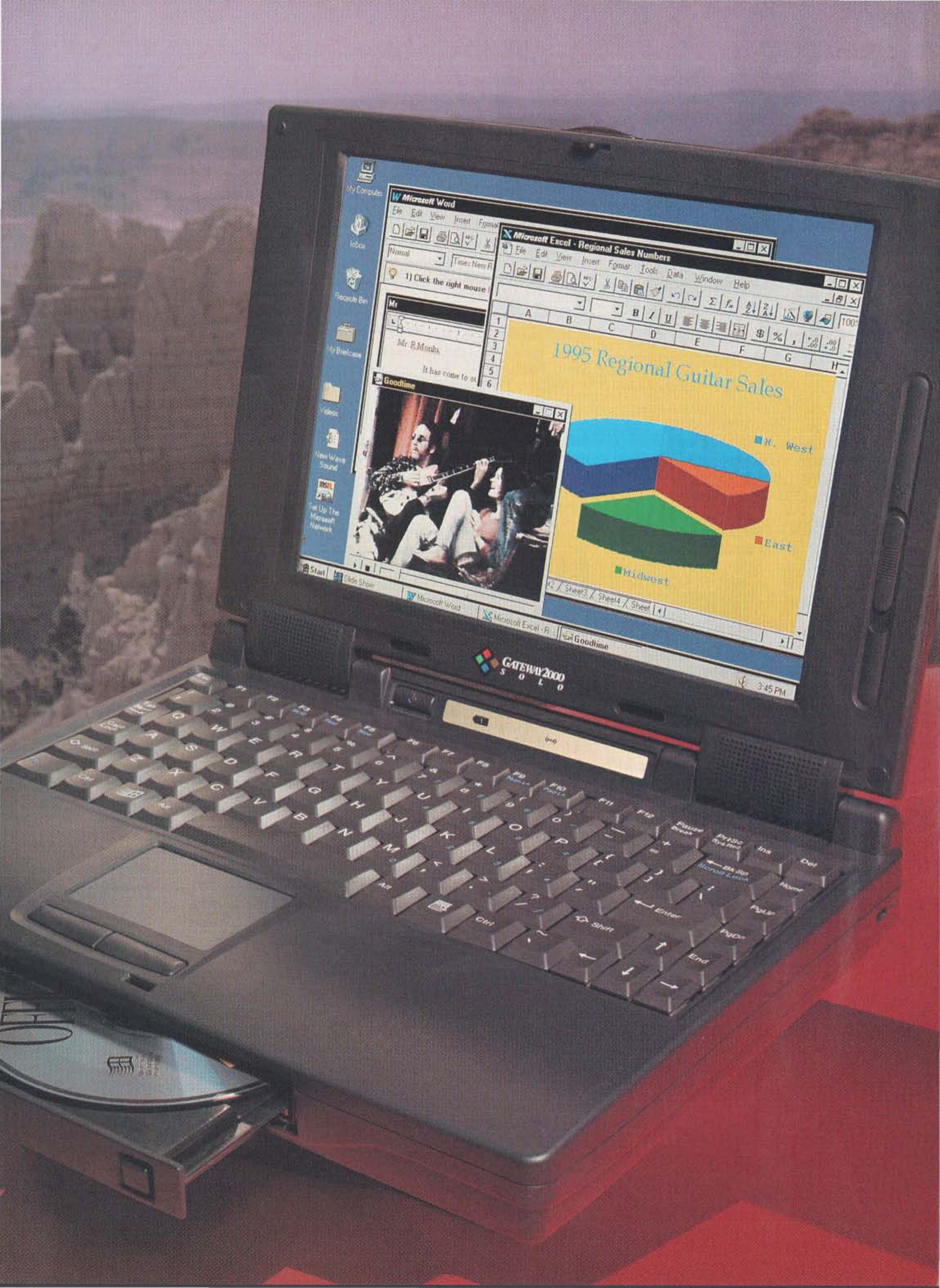
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Happy Anniversary

Being a BYTE reader since way back 20 years ago, I had a sort of special feeling going over your anniversary edition (September)—not the least of which was noticing I'm 20 years older and still banging away on a computer keyboard. Twenty years is a heck of a long time. Far more than any other magazine, you have pioneered this industry. BYTE has a place of its own somewhere along with the Apple II and Turbo Pascal.

Gus J. Grubba
gus@sgi.grubba.com

Reading your anniversary articles was a trip down memory lane. I have used or owned many of the computers you mentioned. I have special praise for the Radio Shack Model 100, since it is now the heart and brain of my lawn-watering system. However, it does not use the Z80 CPU as mentioned in your article "Top 20 Small Systems." Many other Tandy machines were driven by the Z80, but the soul of the Model 100 was the 80C85.

Richard Poitras
Missoula, Montana
poitras@montana.com

The Model 100 did indeed use an 80C85, clocked at a blazing 2.4 MHz. We regret the error.—Eds.

The "20 Spectacular Failures" piece lacked one product worthy of inclusion—Microsoft Bob. What an oversized piece of dreck. I also expected to see somewhere in the section at least one entry regarding the Heathkit computers. A lot of us cut our eyeteeth on H-8s. You guys really seem to have a blind spot regarding the Heath company, as I pointed out the last time you did this type of historic review. Put a big pop-up reminder in your database so you don't leave them out again!

Welbrey A. Hill
hillw@freenet.fsu.edu

I am dismayed at the complete avoidance in your anniversary issue of any mention of OS/2, either in the "Most Important Software Products" article or in "The 10 Most Important Programs of Today" sidebar.

OS/2 2.1 was a revolutionary milestone in personal computing. The first real alternative to the MS-DOS/Windows 3.x combination, IBM's OS offered unparalleled backward compatibility. The DOS sessions were fast, protected, and individually customizable without having to reboot. OS/2 ran Windows software as well as native Windows seamlessly on the OS/2 desktop—an accomplishment Microsoft felt was impossible. Flat memory model, true preemptive multitasking (even with legacy software), unheard-of backward compatibility, object-oriented desktop, and a vision for the future make OS/2 a revolutionary product.

As Windows 95 falters from over-marketing and the usual bugs, OS/2 Warp becomes even more attractive as an alternative to Microsoft's offerings.

Tom Robeson
drtom@infi.net

Thanks for your stimulating list of error messages in the twentieth-anniversary issue. From 1983 to 1990, I worked as a freelance writer and used Acorn Computers (6502-based). The last of these machines died with a single intelligible phrase amongst all the garbage on the screen: "Klaatu Barada Nikto," which you may remember from the science-fiction classic *The Day the Earth Stood Still.*

Grant Nightingale
Oxford, England.
100256.1361@compuserve.com

Congratulations on the September issue. I can't, however, understand why you place three versions of the Apple Macintosh among the top 20 small systems and leave out the Commodore 64. The C-64 was a quantum leap when it appeared and was probably the best-selling computer of all time.

On another note, I have every BYTE since the January 1982 edition. Any chance these will ever come out on CD-ROM?

Eduardo Chaves
Campinas, Sao Paolo, Brazil
chaves@turing.unicamp.br

We will add your votes for Commodore's 64 and Amiga in the growing bin of "How could you leave out such-and-such?" letters. Regarding back issues, we do have a BYTE CD-ROM that goes back five years. You can order one by calling (800) 924-6621 or faxing (609) 426-5592. You can also scan our archives on our Web page (http://www.byte.com) or our FTP site (ftp.byte.com).—Eds.

RADical Approach

I just finished reading "The End of Programming" (August). The main problem I've experienced in using rapid application development (RAD) is getting all the necessary design specifications from the full spectrum of clients who will use the new system. We solicited client input from the very start of our project, but as more and more clients use the actual production system, we're finding many needed refinements. And we've been getting feedback from some clients who say they have trouble adjusting to these constant refinements. In order for RAD to work, you need a client base that is willing to provide developers with feedback on the system and be flexible enough to use a continually refined system. Without this client participation, RAD isn't very effective.

Anthony W. Hanson
ahanson@halcyon.com

BYTE Network Project

In his "Web Search" article (September), Jon Udell talks about freeWAIS (the NT port of it) and says that "since multiple search terms combine with OR . . . you depend on the selective power of a single term." This is only partly right: WAIS produces a ranking of result documents where the first entries fit the query better and the later entries don't fit it as well. Thus, you will find documents containing all search terms near the beginning of the ranking list, and documents containing few search terms near the end. In fact, if you access a WAIS server using a WAIS client, you will find that, in addition to the document title, you get a score indicating the match between the document and the query.

I would also like to direct your attention to freeWAIS-sf (sf = structured fields). It improves somewhat upon the standard indexing and retrieval functions of freeWAIS. A very important improvement of

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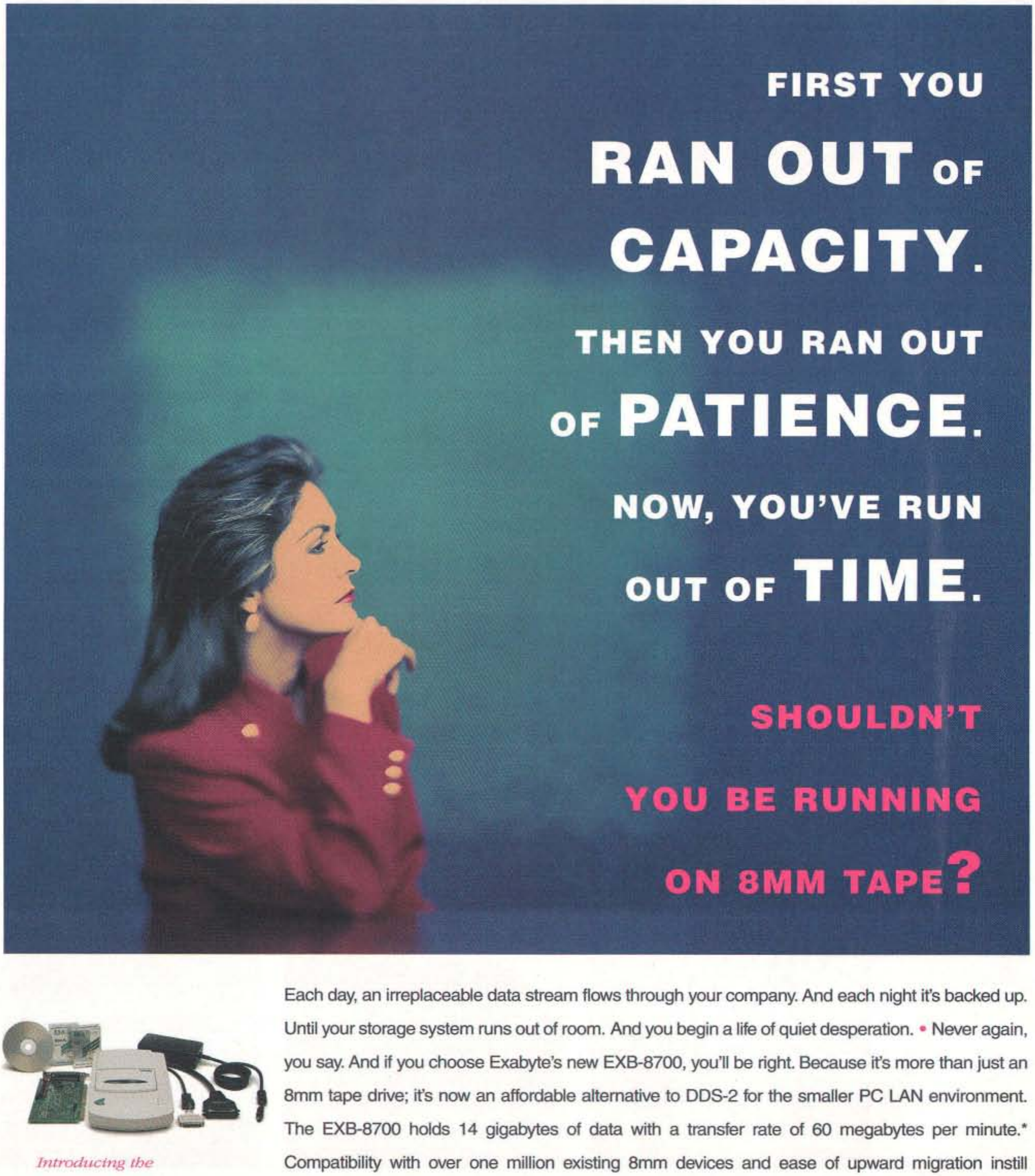

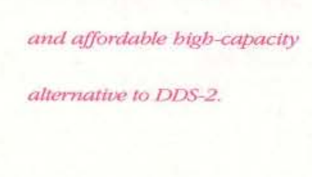

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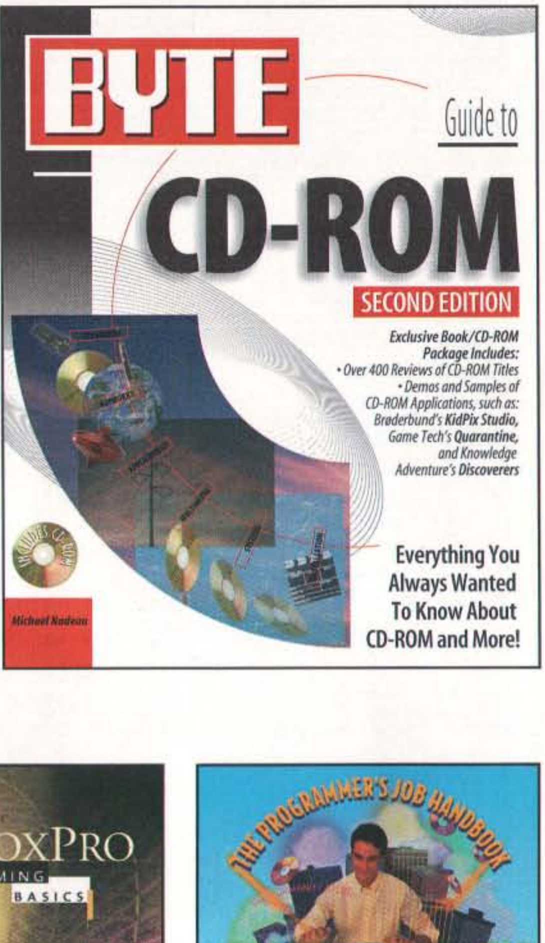
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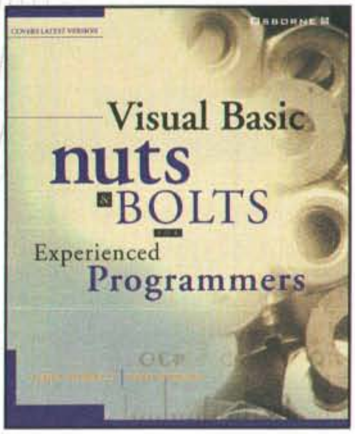

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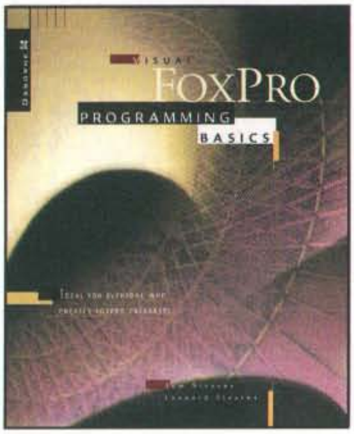

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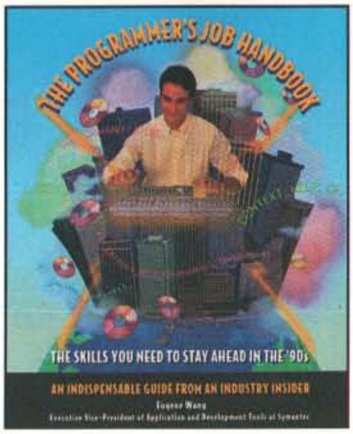
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freeWAIS-sf is the ability to process structured fields. A document is separated into fields specified at run time (based on regular expressions), so there is no hard-wired restriction on what fields there are and how to recognize them. Here's where to find freeWAIS-sf: http://ls6-www.informatik.uni-dortmund.de/freeWAIS-sf/freeWAIS-sf.html

Kai Grossjohann
grossjoh@dusty.informatik.uni-dortmund.de

The arbitrary fielded capability of freeWAIS-sf sounds particularly handy. I like the fact that the Simple Web Indexing System for Humans (SWISH) can look within HTML tags, but it only knows about certain of these kinds of "fields." I, in fact, have an application that wants more specific fielded capability, so I will give freeWAIS-sf a try. Your clarification of the behavior of freeWAIS is also very helpful.
—Jon Udell, executive editor

The BYTE Web Site

Great job on the new navigational layout for your Web site. The new style really helps, especially when a 14.4 connection is the best you can hope for. And thanks for the optional graphics. I hate having to wait on fancy graphics that don't help clarify the page's message. I've found nothing worse on the Web than waiting for graphics that mean nothing after they've finally loaded.

John Alexander
Tuscaloosa, AL
76762.3310@compuserve.com

Letters to the Editor (in Chief)

Once again you have written so biased and inaccurate an editorial that I am compelled to write ("Why I Love/Hate Microsoft," August). You assert that Microsoft deserves credit for Word, Excel, and PowerPoint. Yet none of these products is the premier product in its respective field. You praise Microsoft for its vision of a GUI. That may be praiseworthy, but people spend most of their time working within an application, not the GUI. And Microsoft's "vision" costs untold millions in graphics accelerators just to get decent performance.

Joseph D. Moreno
San Diego, CA

Microsoft's business productivity applications, especially as bundled in the Office suite, control a huge portion of the market. Like it or not, it is these applications, in conjunction with the Windows OS, that have made Microsoft a dominant force. It is not a question of technology. It is an issue of consistency, vision, and aggressive (perhaps too aggressive) exploitation of each fraction of a point of market share.
—Rafe Needleman, editor in chief

I was prompted to respond to Rafe Needleman's statement that "Computers don't cost jobs" ("Old Enough to Know Better," September). As you point out, computers have indeed cost jobs in certain industries and created jobs in others. But counting jobs just doesn't tell the story. You need to look at income distribution. Computers have resulted in a widening of the income gap between the well-educated and the poorly educated. Computers have greatly benefited a well-educated minority and have tended to harm the economic well being of the rest of society. Given the current political climate, it's likely this trend will continue.

Alan Kushnir
72500.2232@compuserve.com

I try to avoid political commentary in BYTE, although as computer technology pervades society, it gets more difficult.
—Rafe Needleman, editor in chief

Image Problems

David Seachrist's NSTL Software Roundup review "Document Image Managers" (May) contained inaccurate conclusions and omissions about our product, PaperClip for Windows. The review overlooked PaperClip's unique Visual Context Processor (VCP) technology, which lets the program integrate with existing applications without special programming. Somehow, Seachrist missed this feature, incorrectly relating it to OCR output and file conversion. In fact, thanks to VCP, PaperClip's folders can be pointed to from numerous other contexts and applications without DDE or OLE.

The other products are islands of technology that will exist outside users' daily application environments without a large investment in systems integration. PaperClip's unique approach obviates that need.

Sol Rosenberg
President and Chief Technology Officer
PaperClip Imaging Software Inc.
Hackensack, NJ

I agree that the scope of the roundup was broad. This is endemic to any new software category. It is true that I misstated the reason for PaperClip's inability to maintain text formatting. It was the OCR engine, and not PaperClip's linking technology, that was the cause. But I continue to question the wisdom of employing VCP technology at the complete exclusion of OLE, a technology that is now well established. ■
—David Seachrist,
NSTL

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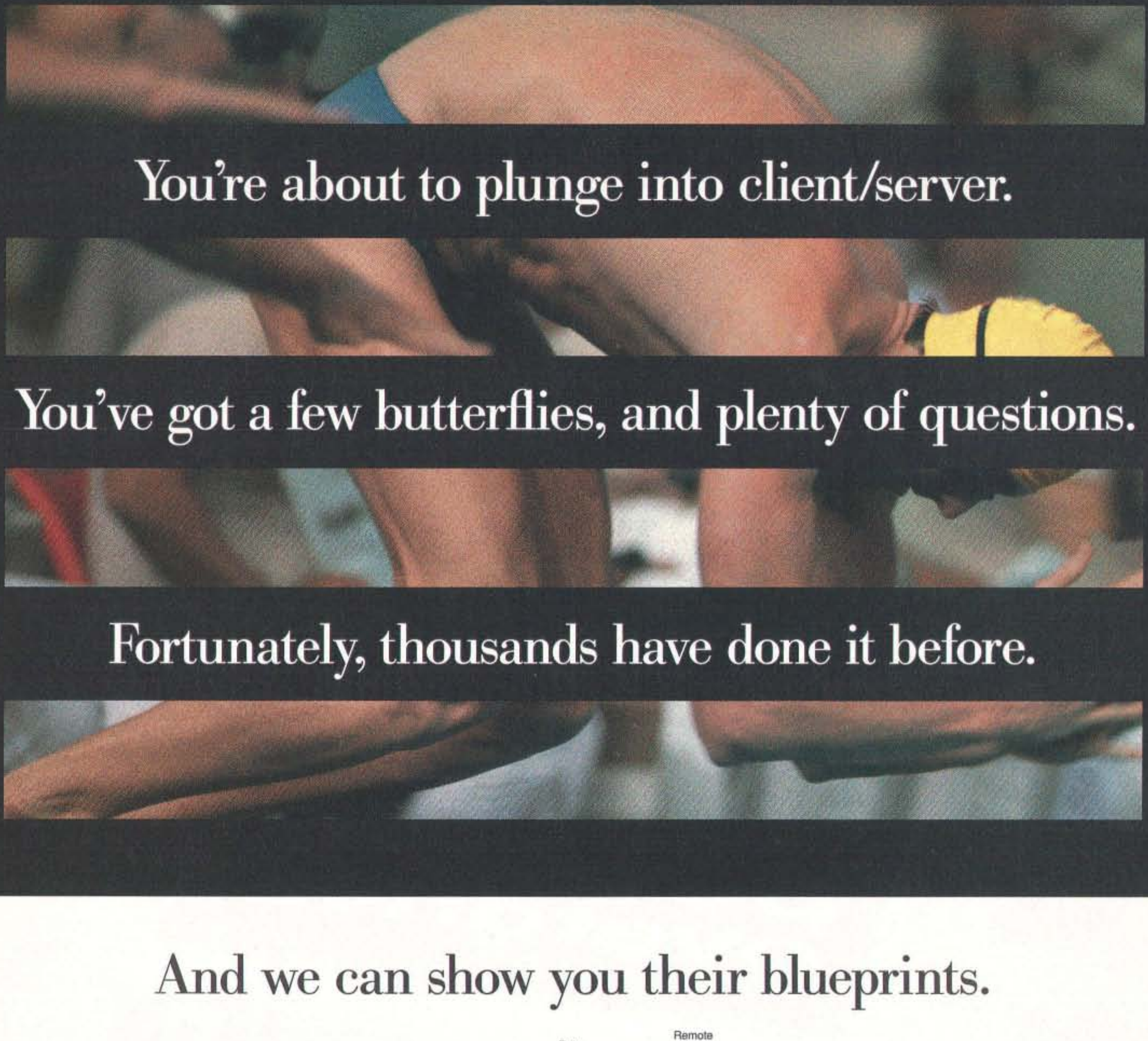

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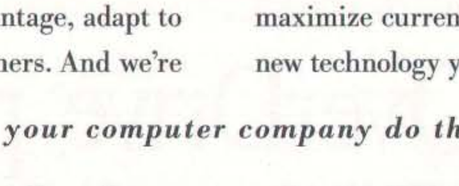

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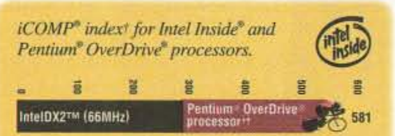

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P6 Expands PC Spectrum

The first P6-based computers will range from affordable (under $4000) PCs to systems selling for more than $10,000

DAVE ANDREWS (WITH ADDITIONAL REPORTING BY MARK REYNOLDS)

Surprise. The first PCs based on Intel's next-generation P6 processor won't be limited to big honking application servers designed to run massive database management systems. Over the next two months, vendors will release a variety of PCs ranging from moderately expandable, low-end (for P6) desktop systems selling for under $4000 to high-end servers. Vendors will also release powerful multiprocessing PC workstations suitable for 3-D modeling, CAD, and visualization.

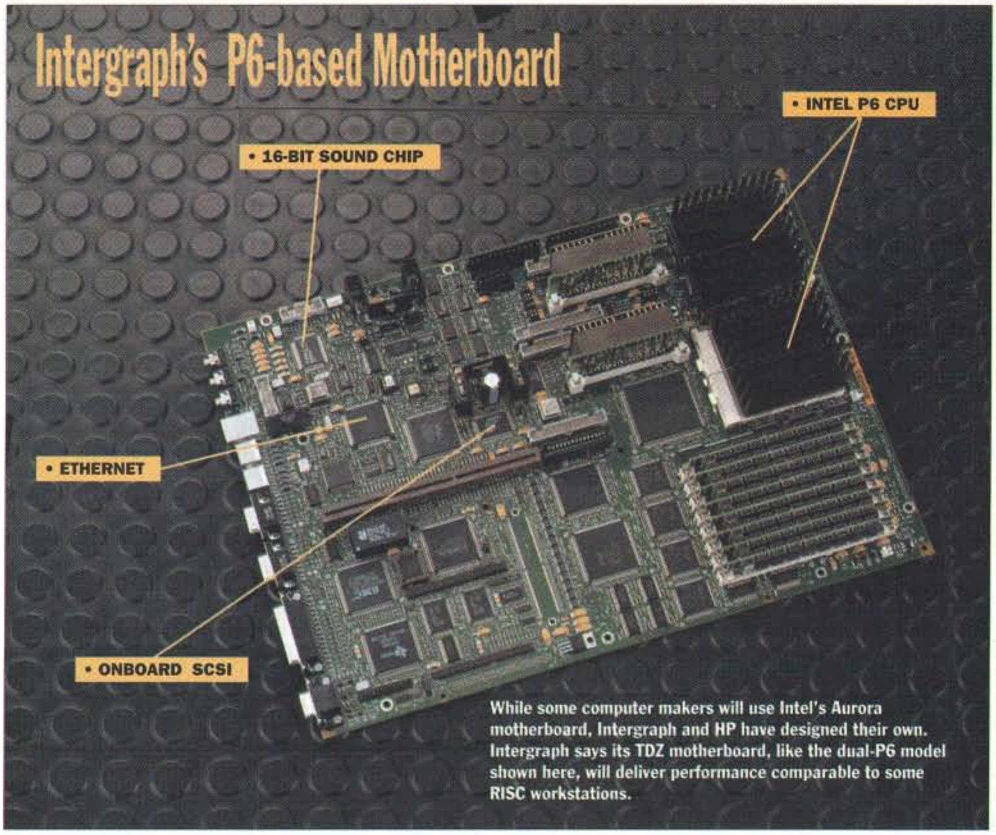
At presstime, most companies that BYTE surveyed declined to release specific information on their P6 plans. However, sources report that many manufacturers, including Gateway, Dell, and IBM, will use—in at least some of their desktop systems—the Aurora motherboard that's manufactured by Intel. The Aurora board is reportedly designed for P6 systems that will fall into the mass market. The Aurora's intended audience explains its feature set: three open PCI slots, enhanced IDE instead of SCSI on the motherboard, no integrated sound or networking, and support for one P6 processor only. Because the motherboard lacks integrated networking and video acceleration, users will likely fill the system's first two PCI slots quickly.

Intergraph's TDZ Interactive series of workstations will be available with up to four P6 CPUs. Prices will range from $10,000 to $38,000.

Intel's position as a supplier of P6 motherboards for desktops and servers could mean good news and bad news for PC vendors. The good news is that in today's highly competitive market with tight profit margins, a vendor using an Intel motherboard can bring a P6 system to market more quickly than if they designed and debugged the motherboard themselves. Companies such as Gateway 2000 (North Sioux City, SD) thrive by integrating readily accessible, standard components into relatively inexpensive bundles that appeal to mainstream consumers. "We were able to take the Pentium and put it in a product that appealed to the mass market," says Rus Graham, Gateway 2000's marketing communications manager for desktop products. Although Graham wouldn't comment specifically on Gateway's P6 product plans, he says that the company's PC strategy would remain the same with the P6.

The bad news, at least for vendors designing their own motherboards, is that Intel's motherboard operation could commoditize the market. Some vendors aren't satisfied with the Aurora's feature set and will provide more add-on slots and integrated components on their motherboards. But vendors have also learned that differentiation achieved through independent motherboard design is more complex with Intel's newest processor: The P6 has about 100 more pins than the Pentium, requires more control signals to handle multiprocessing, and has lower noise margins due to the P6 bus's use of modified Gunning transceiver logic running at 1.5 volts, compared to some Pentiums that run at 3.3 volts (lower voltage means lower noise margins). Some vendors feel Intel's motherboards give their competitors an unfair advantage. "Intel's motherboards allow Compaq wanna-bes," says Mike Lambert, Compaq vice president of product marketing in North America. But Intel's policy also means more vendors will make P6 desktops and servers, which should drive prices down more quickly. Several vendors predict prices for fully loaded desktop P6 systems will drop below $2000 within 24 months of the chip's initial release.

Two computer makers—Intergraph and Hewlett-Packard—have released preliminary information on their own P6 motherboards and systems. "The P6 will be excellent for Windows NT users," according to Jeff Schnabel, product manager of desktop personal computers at HP



While some computer makers will use Intel's Aurora motherboard, Intergraph and HP have designed their own. Intergraph says its TDZ motherboard, like the dual-P6 model shown here, will deliver performance comparable to some RISC workstations.

(Santa Clara, CA). "We designed our motherboard to better serve those users." HP's high-end P6-based Vectra, which is expected to extend HP's XU line of PCs, will offer features that power users expect, such as Ultra SCSI and a 16-bit Sound Blaster chipset integrated on the motherboard. The high-end Vectra will also support ECC memory and symmetric multiprocessing (through a socket that accepts a second P6). It will also have four open PCI slots, compared to the Aurora's three, though HP says separate network and video cards will fill the first two slots.

HP's entry-level system is based on a modified version of its P6 motherboard. The low-end Vectra will be a single-CPU machine that doesn't offer ECC memory, SCSI, or integrated networking. Prices were not final at presstime, but HP says the less expensive Vectra will sell for a price that's at or slightly above current prices for a high-end 133-MHz Pentium-based Vectra XU.

The P6 also lets vendors like Intergraph (Huntsville, AL) that develop high-end systems for 3-D CAD and graphics compete more readily with midrange RISC processors such as Digital Equipment's 266-MHz 21064A. Intergraph's TDZ Interactive line of 3-D workstations (dual-P6 motherboard shown above), which will range in price from $10,000 to $38,000, will be available with one to four P6s and Intergraph's GLZ OpenGL 3-D accelerator cards.

"We believe that a P6-based system will deliver performance that's equal to or better than RISC processors like Mips' 250-MHz R4400 and the 21064A," says Chandler Hall, Intergraph's product marketing manager. "But at a lower price and with binary compatibility with x86 applications and the underlying hardware drivers for networking and graphics cards."

Although BYTE tests show that the P6's performance drops to Pentium-level performance when running 16-bit operating systems such as Windows 3.1, Intergraph says that still beats the 486-level or lower performance you get from a RISC workstation running an x86 application in emulation.

Head-to-head comparisons between these first P6 systems and competing RISC workstations were not possible before we went to press, as P6 system vendors were still optimizing performance. Andrew Allison, a consultant and the editor of *Inside the New Computer Industry* (Carmel, CA), estimates that the most powerful RISC processors, such as Digital's 21164 Alpha CPU, will offer better integer and superior floating-point performance to the P6. And RISC vendors are not standing still as Intel prepares to formally announce P6 pricing in November. Digital, for example, was expected to announce in late September a line of Windows NT workstations, based on 233- and 266-MHz 21064A Alpha processors, that will sell in the $4000 to $6000 range. But Allison says the P6 puts the x86 camp within striking range of midrange RISC workstations. Says Allison, "The P6 clearly represents a threat to the [RISC] workstation and server markets."

VENDORS READY FOR P6

Companies were somewhat vague about their plans for new P6 systems at presstime. However, our surveys of select vendors indicate that most desktop systems will ship with at least 16 MB of RAM and a 1-GB hard drive. Look for the earliest units, such as those from Intergraph, to hit the streets in November.

AST Computer (Irvine, CA)	Manhattan series of dual-processor application/database servers
Compaq (Houston, TX)	Will announce servers and desktop systems when Intel officially announces the P6 chip
Digital Equipment (Acton, MA)	Single- and dual-processor Celebris XL desktop systems, featuring 64-bit PCI and upgrade path to Alpha processor; and the single- and dual-processor Prioris server systems, with 64-bit PCI
Hewlett-Packard (Santa Clara, CA)	Single-processor Vectra VT desktop system; and the single- or dual-processor Vectra high-end system, along with P6 servers
IBM PC Company (Somers, NY)	Single-processor PC 300 desktop system, with 16 or 32 MB of RAM, 1.2- or 2-GB hard drive, Matrox Millennium graphics accelerator, and Ultra SCSI adapter
Intergraph (Huntsville, AL)	Single- and dual-processor TDZ Interactive workstations (quad-processor model will come later); single-processor systems are upgradeable to dual processors, and the dual-CPU systems are upgradeable to quad processors
Dell (Austin, TX)	150-MHz P6 in Dimension XPS system; P6 version of OptiPlex in spring of 96
Siemens-Nixdorf (Augsburg, Germany)	P6 version of Scenic PC line

NETWORK MANAGEMENT

End Migration Headaches

Upgrading from NetWare 3.x to 4.1 is a time-consuming, labor-intensive task. New management tools that help speed the migration have arrived.

Network administration consumes the largest portion of a LAN staff's time (see graph). Over a three- to five-year period, administration costs can be five times more expensive than the purchase price of all networking hardware and software, says Forrester Research (Cambridge, MA).

Novell's NetWare Directory Service (NDS) helps reduce administration costs in a number of ways. NDS's single log-on to multiple servers and virtualization of network resources eliminate the need for users (or applications) to know the exact physical location of these resources. Instead of specifying a server name, volume name, and directory path, a LAN administrator using NDS assigns a unique alias to a directory for users and applications to use. This saves costs when a network resource, such as a printer or an application, gets relocated. Additionally, when using NDS, administrators can more easily handle frequently occurring, time-consuming tasks, such as adding new users and changing existing users' access rights.

To help people upgrade to NDS more easily, several companies have released migration utilities. Some of the more interesting tools include MIGRATE.EXE from Novell (Provo, UT; 801 429-7000), Double-Take from Network Specialists Inc. (Lyndhurst, NJ; 201 804-8400), DS Standard from Preferred Systems (West Haven, CT; 203 937-3000), and the REXXWare Migration Toolkit from SimWare (Ottawa, Canada; 613 727-1779). Each tool performs a different type of function, and some complement one another when used at the same time.

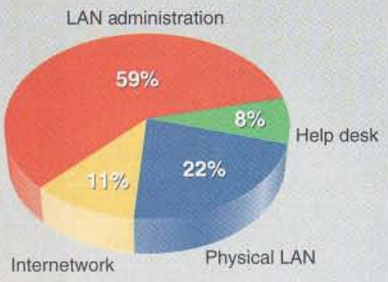
Novell's MIGRATE.EXE, a utility bundled with NetWare 4.1, lets you map all bindery objects on NetWare 2.x, 3.x, and 4.x servers into a single NDS container. The program also migrates system log-in scripts to help make the transition from 3.x to 4.x easier.

Preferred Systems' DS Standard is a Windows-based tool that helps an organization plan and administer NDS. Such tools let companies, when they move to an enterprise-wide directory service, also reexamine their corporate networking structure. This reexamination is necessary because many LANs have been thrown together haphazardly. NDS allows organizations to design a corporate LAN hierarchy that more closely matches the company's business units and their functions. DS Standard helps in this type of planning by discovering NetWare 2.x and 3.x bindery-based servers, as well as NetWare 4.x servers, and letting you merge separately created directory trees into one directory structure.

Another migration tool, which can be used as a stand-alone utility or in conjunction with DS Standard, is NSI's Double-Take. The Double-Take data-replication tool (designed for data backup) has many uses in server migration. With Double-Take, a LAN manager can migrate user and file information from NetWare 3.x servers to 4.1 servers. A manager can also use Double-Take to keep existing 3.x servers operational while moving to 4.x. In this scenario, any changes, such as adding a user to a 3.x server or modifying access rights, will be replicated to the 4.x server in real time.

SimWare's REXXWare Migration Toolkit automates many of the repetitive steps required during migration. The tool is based on REXXWare, an automation scripting tool for the NetWare environment. One of this toolkit's strengths is that it automates tasks in an intelligent way. For example, in many organizations, a user may have separate accounts on a handful of NetWare 3.x servers. Ideally, when all 3.x servers have been upgraded to 4.1, you'd want the user to have a single account. With the REXXWare Migration Toolkit, duplicate files and objects are flagged when they're being migrated so that a LAN manager can identify redundancies and decide how to handle each situation as it arises. **—Salvatore Salamone**

Why Move to NDS?



The bulk of the annual network-support cost per user are recurring LAN-administration costs, says Forrester Research (Cambridge, MA). NetWare Directory Service simplifies NetWare management, and NDS migration tools can make the transition to Netware 4.1 easier.

MICROSOFT STRENGTHENS WINDOWS DIRECTORY SERVICES

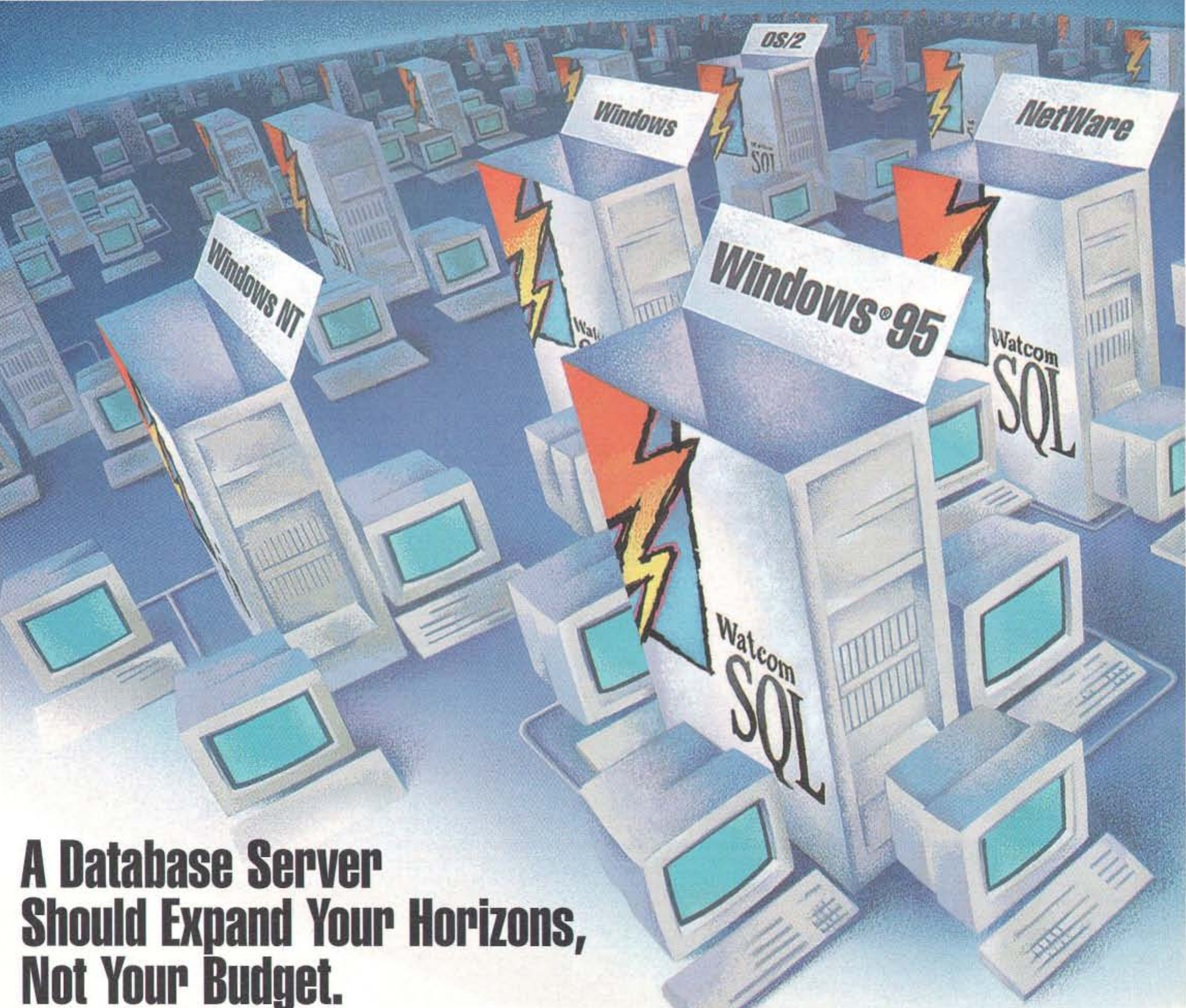
Microsoft's Windows dominates the business desktop environment, and now the company is targeting the enterprise with its Windows NT, SQL Server, and other Back Office products. However, network managers can encounter and must often manage several different directory services in an enterprise. To simplify this management, Microsoft is promoting new Open Directory Service Interfaces (ODSI), a set of APIs that will let Windows NT interoperate with the directories of other systems, including Novell's NetWare Directory Service, Banyan Systems' StreetTalk, Lotus' Notes, X.500, or any other directory for which someone writes a service provider.

With ODSI-enabled applications and operating systems, network administrators will be able to manage different directories from a single management console. Thus, a network-management program such as Microsoft's Systems Management Server could handle multiple back-end directory services.

Microsoft has already developed two ODSI interfaces. One, the Network Provider Interface, allows for a single log-in to multiple directories. The other, called WinSock Resolution and Registration, provides a way to register an application with multiple directories.

The company plans two other interfaces: An OLE Database interface that allows access to databases, and an OLE Directory Services interface that allows for the management of common directory objects. The first versions of network OSes and management applications that support ODSI will probably appear in 1996.

Jamie Lewis, president of networking consultancy The Burton Group (Salt Lake City, UT), says ODSI is a significant step forward. "It will give Windows applications access to directory services via native Windows interfaces," says Lewis. "ODSI could also help Banyan and Novell make StreetTalk and NDS more successful because more applications will use directory services." **—S.S.**



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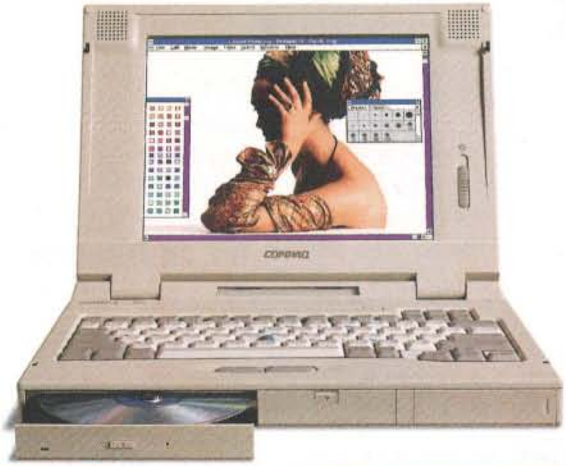

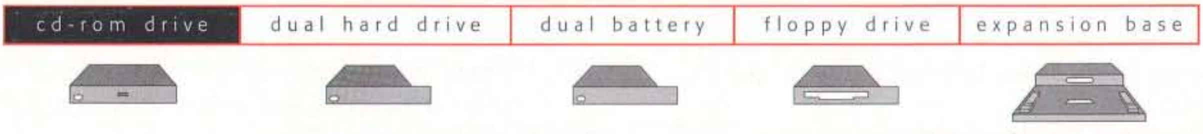

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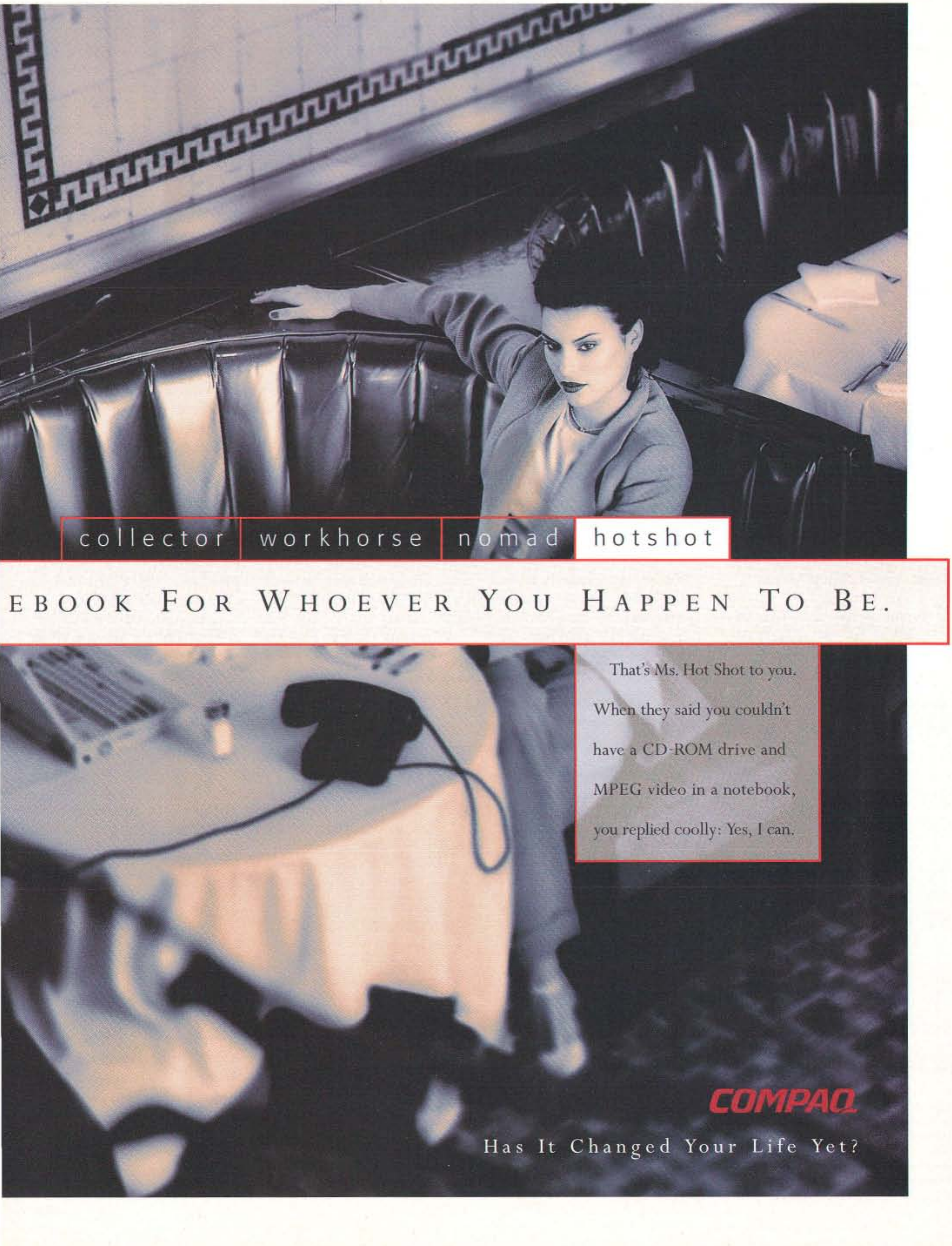

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WINDOWS 95 AND NETWORK MANAGEMENT

Still a Work in Progress

Windows 95 has many enhancements that should improve its network manageability compared to previous versions of Windows. However, network managers moving to Win 95 will have to wait for a few important components. Other features will require an upgrade to NT.

Win 95's improved networking capabilities include built-in support for network protocols TCP/IP, NetBEUI, IPX/SPX, and PPP; easier configuration when used with Plug and Play–compliant hardware; and protected-mode, 32-bit clients for NetWare and Microsoft networks. But work progresses in other areas.

One area of Win 95 that should improve soon is its support for non-Microsoft networks and NetWare 4.x. Although Win 95 supports NetWare 3.x (and NetWare 4.x through bindery emulation), neither Microsoft nor Novell currently have Win 95 clients that support NetWare Directory Services (NDS). Microsoft and Novell are both addressing this by developing separate NetWare clients that support NDS. Network OS vendors Banyan Systems and Digital Equipment also say they will release 32-bit clients for Vines and PathWorks this fall.

Other developers are addressing programming interfaces for desktop management. Although Microsoft is a member of the Desktop Management Task Force (DMTF), the company is reportedly developing its own interfaces for collecting and reporting information about PCs on a network. The DMTF, which also includes Hewlett-Packard, Intel, Novell, Digital Equipment, and IBM, has defined standards for several groups of components, including software, PC, and network interface cards. Specifications for other types of hardware are still in progress.

Sources report that Microsoft is encouraging network management vendors to write to OLE interfaces that will pull information about PCs from the Win 95 registry.

Although this effort could compete directly with the DMI, it appears that Microsoft will support other management techniques through a foreign name space that will map the DMTF's Management Interface calls as well as those made by SNMP-based programs into OLE calls.

Programs such as Site Inventory 4.0 from McAfee Associates (Santa Clara, CA) or CA-Paradigm Problem Manager from Computer Associates (Islandia, NY) currently have to resort to a combination of querying the Win 95 registry and low-level "sleuthing" to discover what software and hardware components are on any given PC. These vendors say it would be easier if they could query PCs in a standard way. But there are many standards, including the DMTF's, Microsoft's, and another one from Compaq.

"Microsoft's not supporting DMI is not a big thing, because we've had to build the discovery service [of CA-Paradigm Problem Manager] outside of the DMI anyway," says Yogesh Gupta, CA senior vice president of product strategy. "But as DMI becomes a viable standard, we'll support it." For other companies, the lack of DMI support in Windows 95 *is* a big deal.

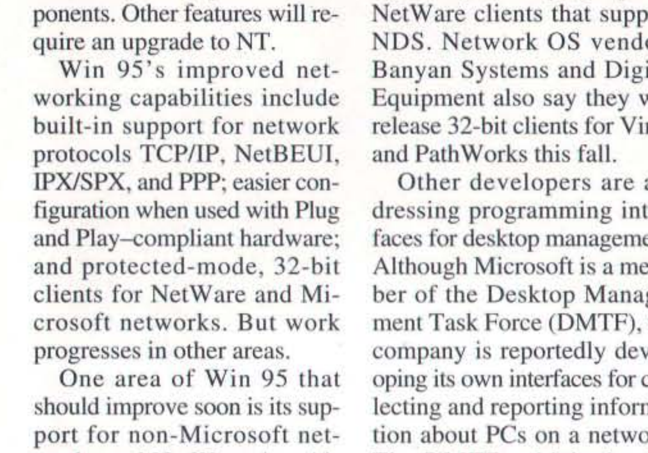
The DMI specification calls for a service layer to be present on a PC. This service layer, which DMI proponents feel should be integrated into all OSes, is a small program that resides locally on a PC and collects information about products, manages the information in the local PC's Management Information Format (MIF) database, and passes it to management applications when requested. DMI advocates had hoped Microsoft would include a DMI service layer in Windows 95, but that didn't happen. "That leaves us with a short-term problem—how to deliver those management capabilities," says Ed Arrington, chairman of the DMTF.

One solution is for PC vendors to add the service layer themselves, as Digital Equipment (Maynard, MA) did with its new line of Celebris GL PCs for Win 95. But not all PC vendors are supporting DMI.

Other more robust management features available now in NT, such as support for event logging, are not planned for Win 95, say Microsoft officials. The event log provides a way for device drivers, applications, and the OS to record useful data for administrators.

Jamie Lewis, president of the Burton Group (Salt Lake City, UT), a network consulting firm, says it would have been helpful if Microsoft had put event logging into Win 95. But, he says, "Windows 95 is an interim step toward Windows NT. NT was built to be that kind of robust environment." Lewis says event logging is just one example of how, in the long term, Microsoft will target consumers with Win 95 and businesses with NT. **—DLA**

Windows NT Gets a Windows 95 Facelift



Microsoft has begun testing a very early version of the Windows NT Advanced Workstation Shell Update Release (SUR) that adds the Win 95 interface to NT. Microsoft says it was going to wait until the next major upgrade of NT—code-named Cairo—to add the Win 95 interface but decided to accelerate that effort when customers said they wanted a consistent user interface between NT and Win 95. The company is not saying exactly when it will release the SUR. Support for Plug and Play is currently slated for the Cairo release of NT.

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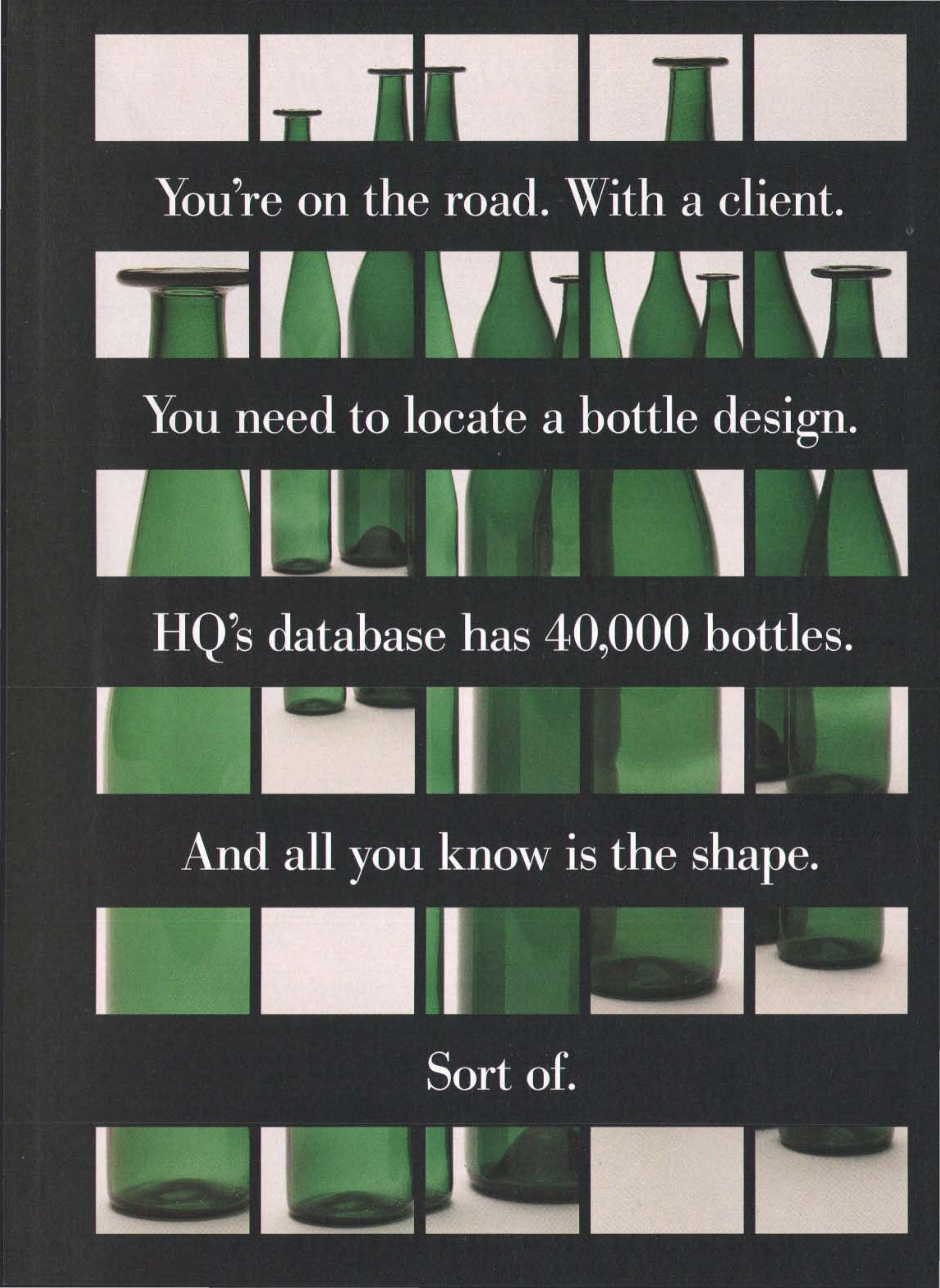

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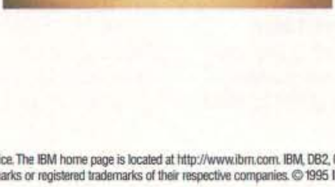

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DESKTOP DISPLAY TRENDS

Flat Displays Squeeze Bulky CRTs

THIN-DISPLAY FUTURE LOOKING ROBUST

COMPANY	PRODUCTS/PROTOTYPE STATUS	MANUFACTURING PLANS
Sony	25-inch plasma-addressed LCD in prototype 40-inch prototype rumored Plasatron TV in Japan in late '96	10,000 units in first year; no mass-production plans announced
NEC	20-inch AC plasma TV in '96 29-inch prototype 40-inch prototype	Investing 10 billion yen to produce 10,000 plasma displays per month Plans to spend 80 billion yen to produce 150,000 units per month by 2000
Fujitsu	21-inch AC plasma monitor/TV in production 42-inch prototype; production expected in '96 55-inch display in '97 or '98	Investing 60 billion yen in plasma-display manufacturing; expects to produce 10,000 units per month in '96 and 100,000 units per month by 2000
Matsushita	26-inch DC plasma display in prototype; production planned for Q2 '96 40-inch DC plasma display in prototype	No decision announced yet
Mitsubishi Electric	20-inch AC plasma display in prototype 40-inch prototype soon	No decision announced yet

When it's time to make a computer-based presentation on a screen, most people turn to projection systems that display images in the 20- to 40-inch-diagonal range. Users who want this size of a picture at their desktop computers have to use a big and bulky CRT display. But soon, a new breed of large-area flat displays will be available, and you can have some of your desk space back.

Three major Japanese companies recently announced they will spend billions of yen to begin large-volume production of plasma-based displays by 1996. The primary market for these displays will be high-end televisions. But computer users should benefit, too, as volume production will drive prices down and let flat displays replace CRTs. Already, bulky displays of more than 20 inches are used for engineering and desktop publishing applications that require large viewing areas. Flat displays will free up desktop space, which is at a premium in Japan and in many U.S. offices.

Plasma displays are manufactured with low-cost/high-yield printing techniques instead of the expensive photolithographic methods used to make LCDs. These electrode printing techniques can be readily scaled to larger-size displays. Fujitsu (Tokyo, Japan) already sells a 21-inch display and recently announced it would soon have a 42-inch variety. NEC and Fujitsu recently announced they both plan to build new production facilities to manufacture AC-driven plasma displays.

These devices work in a way that's similar to fluorescent light bulbs; they use voltage to ignite a gas, forming a plasma. To make a plasma display, manufacturers segment gas pockets into pixels, which are individually addressed. To form a full-color display, colored phosphors are deposited at each pixel site. Says Larry Tannas, an analyst who covers the flat-panel-display industry, "Most users would be happy with the picture quality of these flat displays, and they are brighter than standard TVs."

A third major player, Sony (Tokyo, Japan), announced it will commercialize another technology: plasma-addressed liquid crystal displays (PALCDs). Sony has licensed the technology from Tektronix (Beaverton, OR) and is working with Technical Visions (Beaverton, OR). According to Tom Buzak, president of Technical Visions, PALCDs are not plasma displays but active-matrix LCDs that use a different type of transistor. "The difference is that you replace the silicon transistor with a gas, or plasma switch," Buzak says. PALCDs use the same polarizers, backlights, and color filters as active-matrix LCDs.

Today's 21-inch display from Fujitsu is still expensive: about $8000. But with high-volume production, prices should drop. Fujitsu, for example, expects its 42-inch display to initially cost about 1M yen (roughly $10,000) in 1996, then fall to half that as they reach full production.

—Chris Chinnock

COOL INTERNET SITES

Top Ten Web Sites for Small Business

1 http://www.sbanet.uca.edu/ The Small Business Advancement National Center provides research, training, consulting, and other information.

2 http://kcilink.com Dozens of articles by business columnist Raj Khera and other business-related information.

3 http://www.webcom.com/~seaquest/ A "how to" information resource center for small businesses.

4 http://www.yellow.com A World Wide Web version of the Yellow Pages.

5 http://www.govcon.com Resource center for government contractors.

6 http://www.sbaonline.sba.gov/ The Small Business Administration's Web hangout.

7 http://www.directory.net/lexis-nexis/sba Search here for small-business-related articles or read articles already cataloged in subtopics.

8 http://ptolemy.gis.virginia.edu:1080/reis1.html The Regional Economic Information System database provides local economic data (1969 to 1992) for states, counties, and metropolitan areas. Good for market research.

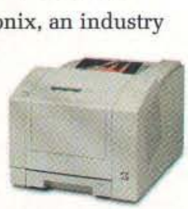
9 http://trinet.com/ucan/ Info for a small business that wants to be the next Netscape and go public.

10 http://dbisna.com/ Financial and demographic data from Dun & Bradstreet.

Source: The First American Group Purchasing Association (New Orleans, LA; 504 529-2030), a group that provides purchasing and information resources to small businesses. List based on member survey and comments.

Color is color, unless it's brilliantly practical.

It's the business printer you've been waiting for. Professional color so reliable, inexpensive and easy to use, it's a practical office tool. Speed? It's the world's fastest desktop color printer at 4 color pages per minute. Cost? Full text pages on plain paper at 3¢ each. Color for 11¢ on office papers. Simplicity? If you can load a stapler, you've mastered this machine. Reliability? Add 700 sheets and let it run overnight. That's robust. Price? At $4,995, nothing in its performance range even comes close. Best of all, it's from Tektronix, an industry leader, making world-class color printers for 13 years. **The Phaser 340 Color Printer. So practical, it's brilliant.**



Call 800/835-6100, Ext. 1037.
http://www.tek.com/CPad?1037

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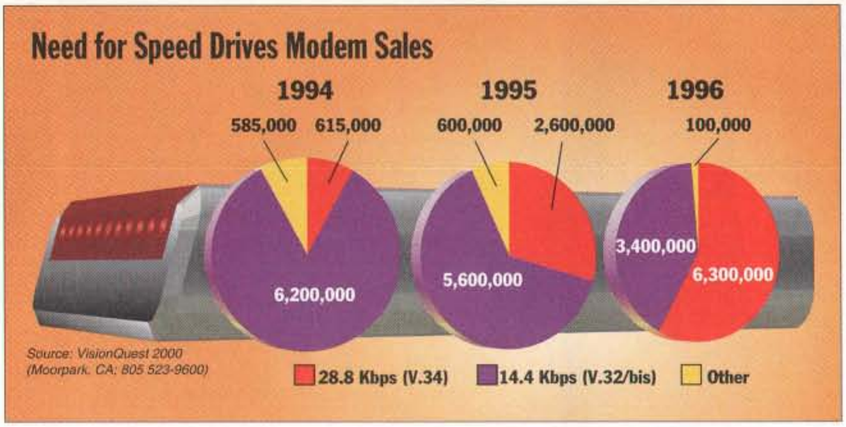
Tektronix

Circle 98 on Inquiry Card.

TELECOMMUNICATIONS

Phone Lines Stymie V.34 Modems

Today's advanced modems push the telephone system to the limit, and users are finding to their woe that in many cases, 28.8-Kbps modems won't deliver their advertised throughput. The result: That blazingly fast 28.8 V.34 modem you bought won't deliver better than 26.8 Kbps except under prime conditions. In fact, performance could be much worse.



Source: VisionQuest 2000 (Moorpark, CA; 805 523-9600)

The need for speed to access the Internet or a private remote network will fuel U.S. aftermarket retail sales of 28.8-Kbps V.34 modems, despite the inconsistency of data throughput.

Even the newest modems with the amended V.34 standard, which allows for speeds up to 33,600 bits per second, won't solve your speed problem. These advanced V.34 modems, from companies such as U.S. Robotics, AT&T Paradyne, and Racal-Datacom, still have to contend with a telephone system that was never meant to handle such high-speed data communications.

Stephen Satchel, president of Satchel Evaluations (Incline Village, NV), an independent modem-testing firm, says the trouble usually isn't the quality of the copper in the phone system's local loops. He says the problems are due to trunk components and switches. "Their soakers, designed to cut down on static, artificially limit the bandwidth that V.34 needs to operate effectively," Satchell says. "Interoffice phone systems also often have artificially narrow channels that introduce distortion in the data channel." This means that even the best V.34 modem talking to the same brand of modem will often top out at 26,600 bps.

Another growing problem, Satchel says, is that the phone companies, in their changeover from analog to digital circuits, are using digital speech compression to get the most voice service from existing lines. That's fine for voice, but it's a disaster for modem users because it closes your effective bandwidth window down to a maximum of 9600 bps. "Entire neighborhoods are being changed over," Satchell says. "Modem users don't have a way out." Indeed, for many of us, the first thing you'll know about the arrival of digital voice compression on your block is when your data communication slows to a fat baby's crawl.

Many other factors determine how fast your modem can pump out data. Some of these, like the UART (universal asynchronous receiver/transmitter) chip, are under your control. But other vital elements are outside your control. For example, early-model U.S. Robotics Sportster modems—those with ROMs older than April 18, 1995—suffer from the spiraling death syndrome. The modem will blithely try to optimize the V.34 connection, but it ends up corrupting the connection so that speeds drop slowly but surely to a horrific 4800 bps. If you think you're running into this problem, you can check your ROM with the modem command ATI7. If you have one of the older ROMs, U.S. Robotics will replace it for free; call them at (703) 982-5151.

A far more common and annoying problem, since it has no solution, is that modems built around the Rockwell chip set do not show consistent speed results, even under laboratory conditions. Satchel says he's seen results ranging from 21,600 bps to 28,800 bps using Rockwell-based modems from such popular vendors as Cardinal, Global Village, Hayes, Supra, and Practical Peripherals, with absolutely no change in the testbed configuration.

A better way to get a consistently fast data connection is through ISDN. The problem with ISDN, which can push your data connection up to 128,000 bps, is twofold. First, you can't get ISDN services everywhere. Some Baby Bells, such as Bell Atlantic, are very ISDN-friendly; others, such as Nynex, are not. The second problem is that local regulators are very inconsistent in their treatment of ISDN. In some states, ISDN is so heavily taxed that it is utterly impractical for private use. In other states, ISDN may be no more expensive than an ordinary additional phone line.

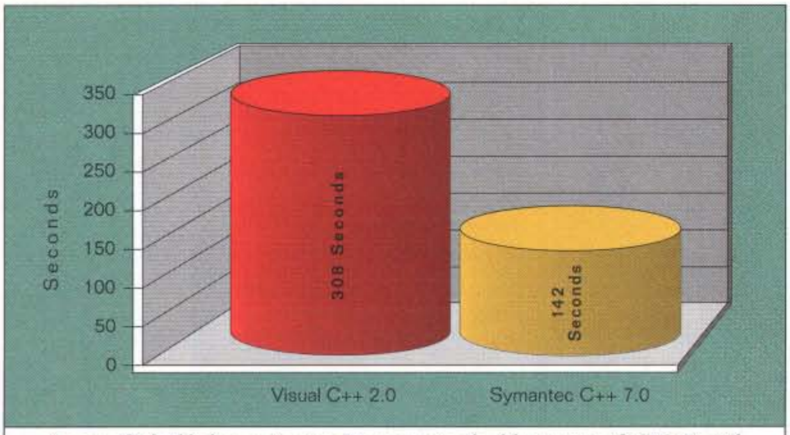
If you can't get ISDN, you may want to investigate a telephone line conditioner. NAI Datacomm (Roswell, GA, 800 778-4479 or http://naidata.com on the Web) has its VFast Modem family of superchargers (about $600 or less), which can optimize modem performance. However, as company officials point out, these products address only problems at the local loop.

For now, we're stuck with less-than-perfect analog modems in an environment that will grow increasingly more hostile to high-speed performance. This should not prevent buyers from flocking to V.34 modems, however (see the graph). "Some users, especially when accessing the Internet, will take any speed improvement they can get," says Ernie Raper, market analyst for VisionQuest 2000 Associates (Moorpark, CA). "Even if the V.34 modem delivers 26 Kbps or 24 Kbps, that's a lot more data being transmitted than 14.4 Kbps." Raper predicts that prices for V.34 modems will drop steadily, which will result in a minor price difference between 14.4- and 28.8-Kbps modems.

In the long term, ISDN, clearly the optimal technical solution, will be the future of end-user data communications. For the next few years, though, take all claims of modem speed with a dose of salt.

—Steven J. Vaughan-Nichols

ARCHITECT. NAVIGATE. BUILD. DEBUG. NEW SYMANTEC C++ 7.0 IS THE FASTEST WAY TO DO IT ALL.



Average of 3 builds done on Pentium Processor using the debug version of MFC 3.0 with VC++ 2.0 makefiles. Borland excluded due to lack of support for MFC.

Imagine roaring through the development process in a fraction of the time it takes with Microsoft Visual C++ or Borland C++. All you need is new Symantec C++ 7.0 with full support for Windows 95 Preview Program, Windows NT 3.5, Windows 3.1 and DOS.

THE FIRST TRULY OBJECT-ORIENTED C++ ENVIRONMENT.

Symantec C++ 7.0 is the only C++ that lets you architect and navigate your application with a dynamic Class Editor and graphical Hierarchy Editor. This great new system incrementally parses your C and C++ code and displays an up-to-date structural model of your program without compiling. But that's only the beginning. It also lets you modify any class's inheritance graphically. Plus it automatically locates any class implementation, and much more!

THE NETBUILD REVOLUTION.

Now you can build applications faster than you've ever imagined. With the new NetBuild,™ you can automatically distribute the build process over multiple computers on your LAN, dramatically reducing build times.

In addition, AppExpress,™ ClassExpress,™ and ProjectExpress,™ give you Wizard-like functionality to boost your productivity.

And to make your link-cycle lightning-fast, there's new 32-bit OPTLINK® 6.0 – the world's fastest linker.

For building great Windows resources easily, we've added ResourceStudio – the new OLE 2.0-based resource editor that supports the widest range of Windows resources including Windows 95.

POWER DEBUGGING FOR WINDOWS 3.1 AND NT.

Symantec's Integrated Development and Debugging Environment (IDDE) provides the most powerful debugging features including Thread View, Inspector View, hardware watchpoints and low-level debugging.

Of course, all of these productivity-boosting tools are integrated with a language that supports key standards like ANSI C++ (exception handling, templates and RTTI) and NT structured exception handling. And unlike Borland, Symantec supports MFC and includes it free.

In short, no other C++ lets you do it all this fast. Call the toll-free number below and see for yourself.

CLASS EDITOR AND HIERARCHY EDITOR
dramatically increase your productivity.

NETBUILD
distributes the build process across networked resources for the fastest build times.

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Preview as well as Windows NT 3.5, Windows 3.1 and DOS.

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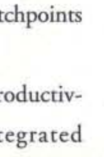

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Circle 105 on Inquiry Card.

We are Gateway 2000.

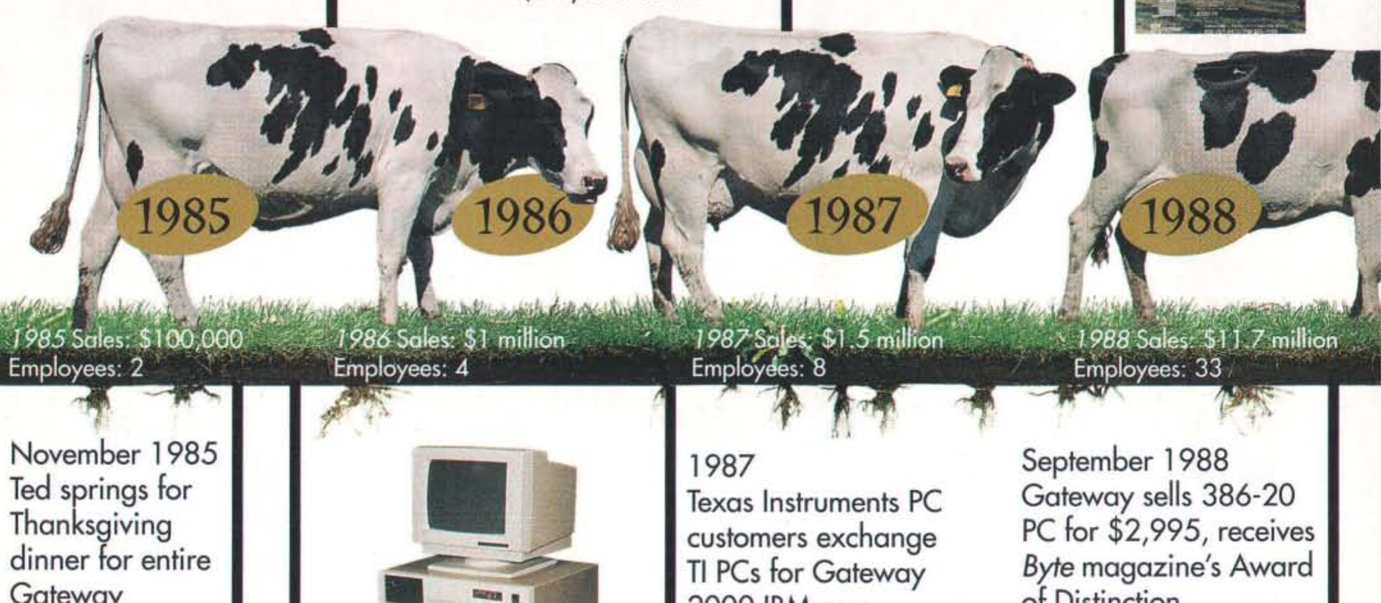
August 1985
"Hey, Mike ... call me crazy but I've had this craving all day to start a computer company!"
Ted Waitt

September 5, 1985
Congratulations, it's a computer company! Gateway 2000 is born at the Waitt Family Cattle Farm outside of Sioux City, Iowa.

August 1985
Ted's grandma, "Momo," takes a leap of faith and becomes Gateway's first principal investor securing a $10,000 loan.

April 2, 1986
The Livestock Exchange Building at the Sioux City Stockyards: Gateway's first home away from home.

February 1988
25 systems built and shipped in one day! All 10 phones ringing off the hook from Gateway's first major ad in *Computer Shopper*, "Computers from Iowa?"



1985 Sales: $100,000
Employees: 2

1986 Sales: $1 million
Employees: 4

1987 Sales: $1.5 million
Employees: 8

1988 Sales: $11.7 million
Employees: 33

November 1985
Ted springs for Thanksgiving dinner for entire Gateway workforce (Mike Hammond).

1986
Gateway 2000 ships its first PC.

August 3, 1986
Shipping clerk covers for Ted over lunch and becomes Gateway's first sales rep.

1987
Texas Instruments PC customers exchange TI PCs for Gateway 2000 IBM compatibles.

February 1987
Ted and Mike get sick of looking at each other. Up go the first cubicle walls!

1987
Shipping clerk/Sales Rep can't pronounce "peripherals." So we focus on systems and ship our first 286 PC for $2,295.

September 1988
Gateway sells 386-20 PC for $2,995, receives *Byte* magazine's Award of Distinction.

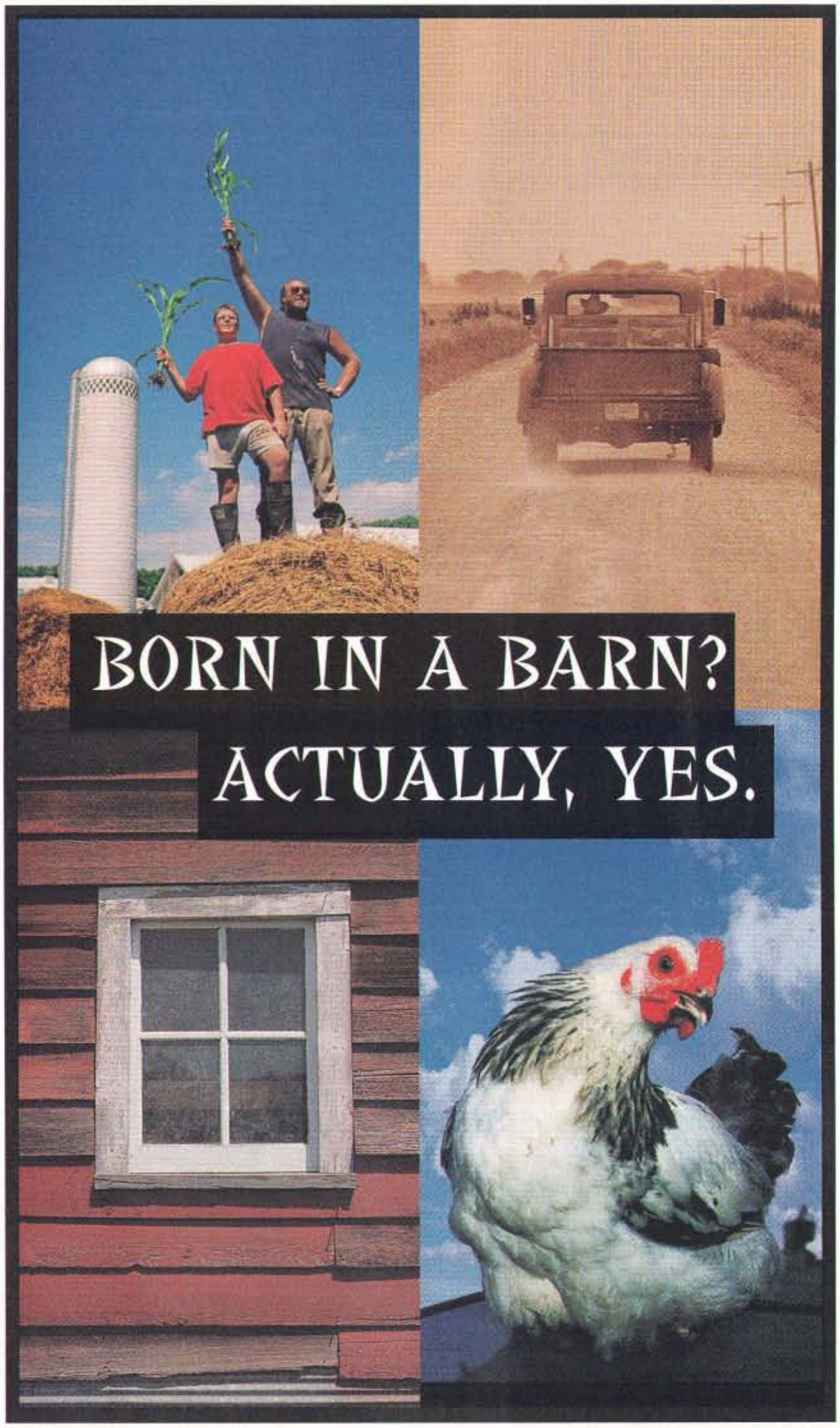
September 1988
Gateway herd finds greener pastures in Sergeant Bluff, Iowa (we moved there).

Industry First!

1988
EGA color monitors standard on all systems.

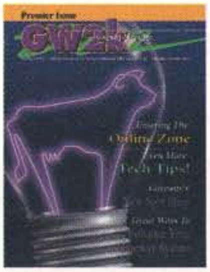
We will always be happy, but we will never be satisfied.

It started as a dream, born on an Iowa farm. Today, 10 years later, the same company that once clocked in by a rooster crow is recognized as the nation's PC industry leader. The Gateway 2000® secret? Give PC buyers a quality product, the latest technology, and incomparable service — all at an unparalleled value. Our hard-working employees know what it takes to get the job done right. And we're ready to outdo ourselves in the next decade and beyond.



intel inside®
pentium® PROCESSOR

May 1995
Gateway's P5-120 is named the "fastest PC in the world," by *PC/Computing*.



March 1995
Premiere issue of *GW2k: Gateway Magazine.*

May 1995
Technical support completes 12,046 calls in one day! All techs treated to sparkling cider in plastic champagne glasses.

July 1995
Gateway ranks first among Intel/Windows PC manufacturers in brand loyalty.

10th ANNIVERSARY SYSTEM

- Intel® 133MHz Pentium® Processor
- 16MB EDO Performance-Enhanced Memory
- 256K Pipelined Burst Cache
- **1.62GB 9ms EIDE DMA Mode 2 Hard Drive**
- PCI Enhanced IDE Interface
- **Matrox® MGA™ Millennium™ 2MB WRAM Graphics Accelerator**
- **6X EIDE CD-ROM**
- 16-Bit Ensoniq® Wavetable Sound Card & **Altec™ Lansing Surround Sound Speakers w/ Subwoofer**
- **TelePath® 28.8 Fax/Modem Communication Center**
- 3.5" Diskette Drive
- **17" .26dp Vivitron™ Color Monitor**
- 9-Bay Tower Case
- **AnyKey®+ Windows**
- MS Mouse 2.0
- **Microsoft® Windows® 95**
- **10th Anniversary System Software Collection: MS Office 95, Professional Edition and Generations**
- **Gateway Gold™ Premium Service**

$3999

intel inside pentium PROCESSOR

Designed for Microsoft Windows 95

November 1994
New Gateway facility opens in Kansas City.

December 1994
The Liberty small notebook makes its debut.

Industry First!

June 16, 1995
Gateway is first to offer Windows 95 as a free upgrade on all standard configurations.

July 28, 1995
Gateway goes "down under" to Australia.

August 1, 1995
Gateway Gold Service and Support program unveiled.

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We share the vision of being our customers' only logical choice.

Industry First!

1989
It doesn't get any better than this — standard VGA monitors!

June 1989
Gateway goes online with GW2k BBS.

December 1989
McGraw-Hill purchases 386-20s and achieves immortality as Gateway's first major Fortune 500 customer.

1991
Gateway becomes first company to win all four *Computer Shopper* Best Buy desktop awards.

Industry First!

February 1991
Gateway is first to introduce non-interlaced monitors on all systems.

April 1991
Gateway introduces cow-spotted boxes.

Industry First!

February 1992
Customers rejoice! Gateway begins offering choice of application software with new systems at no extra charge.

1992
Barely seven years old and already Microsoft PC Manufacturer of the Year.

1993
Gateway offers first Family PC multimed system for $1995.

August 1993
The ColorBook and HandBook 486 ente Gateway's stellar product lineup.

Ind F

May 1994
Gateway announce three-year warranty all desktop PCs and monitors.

July 1, 1994
Gateway opens a showroom in Paris, France.

1989 Sales: $70.5 million
Employees: 176

1990 Sales: $275.5 million
Employees: 600

1991 Sales: $626.7 million
Employees: 1,300

1992 Sales: $1.1 billi
Employees: 1,850

1990
The population of North Sioux City reaches a whopping 2,019.

Industry First!

May 1990
Microsoft Windows is now standard on all Gateway systems.

October 1990
Gateway's first 486 system hits the market value-priced at $5,295.

April 1991
Technical support completes a record number of 2,800 calls in one day!

March 1992
Technical support holding queue is empty for the first time in company history.

May 1992
Going mobile with our first portable computers, including the HandBook, the industry's first subnotebook.

Industry First!

October 1993
Holy leprechauns! Gateway Europe se up shop in Dublin, Ireland.

In

September 1993
Gateway introduces first VESA system.

October 1993
Gateway offers our first Pentium system, the P5-60, for $35 and sweeps *Computer Shopper's* Be Buy awards for thir consecutive year.

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Gateway 2000® Family PC™ Systems

P5-75 FAMILY PC

- Intel® 75MHz Pentium® Processor
- 8MB DRAM
- 850MB 10ms DMA Mode 1 EIDE Hard Drive
- PCI Enhanced IDE Interface
- 32-Bit PCI Graphics Accelerator w/ 1MB DRAM
- 4X EIDE CD-ROM, 16-Bit Sound Card & Altec™ ACS-40 Speakers
- TelePath® 14.4 Fax/Modem Communication Center
- 3.5" Diskette Drive
- 15" .28dp CrystalScan® Monitor
- 7-Bay Desktop Case
- **104+ Keyboard** & MS Mouse 2.0
- **Microsoft® Windows® 95**
- Generations Software Collection
- **Gateway Gold™ Service & Support**

$1899

P5-100 FAMILY PC

- Intel 100MHz Pentium Processor
- 8MB EDO Performance-Enhanced Memory
- **1GB 9ms DMA Mode 2 EIDE Hard Drive**
- PCI Enhanced IDE Interface
- 64-Bit PCI Graphics Accelerator w/ 2MB DRAM
- 4X EIDE CD ROM, 16-Bit Sound Card & Altec ACS-40 Speakers
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- 3.5" Diskette Drive
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- 7-Bay Desktop Case
- **104+ Keyboard** & MS Mouse 2.0
- **MS Windows 95**
- Generations Software Collection
- **Gateway Gold Service & Support**

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P5-120 FAMILY PC

- Intel 120MHz Pentium Processor
- 8MB EDO Performance-Enhanced Memory
- 256K Pipelined Burst Cache
- **1GB 9ms DMA Mode 2 EIDE Hard Drive**
- PCI Enhanced IDE Interface
- 64-Bit PCI Graphics Accelerator w/ 2MB DRAM
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- **MS Windows 95**
- Generations Software Collection
- **Gateway Gold Service & Support**

$2899

Generations SOFTWARE COLLECTION

- Microsoft® Encarta®'95 • MS Bob™ • MS Money 3.0 • MS Works 3.0 • MS Publisher 2.0 • MS Publisher Design Pack • MS Cinemania®'95 • MS Bookshelf® 95 • MS Composer Collection: Beethoven, Mozart and Schubert • MS Wine • MS Arcade: Missile Command™, Asteroids, Tempest™, Centipede® and Battlezone™ • MS Dinosaurs • Mayo Clinic® Family Health Book • and Mayo Clinic Family Pharmacist • plus 31 popular MS entertainment games.

Gateway 2000 Manufacturing, North Sioux City, South Dakota, is ISO 9002 Certified.

ISO 9002 SGS

Professional Systems

P5-75

- Intel 75MHz Pentium Processor
- 8MB DRAM
- 850MB 10ms DMA Mode 1 EIDE Hard Drive
- PCI Enhanced IDE Interface
- 32-Bit PCI Graphics Accelerator w/ 1MB DRAM
- 4X EIDE CD-ROM Drive
- 3.5" Diskette Drive
- 14" .28dp CrystalScan Color Monitor
- 7-Bay Desktop Case
- **104+ Keyboard** & MS Mouse 2.0
- **MS Windows 95**
- **MS Works 95**
- **Gateway Gold Service & Support**

$1599

P5-100

- Intel 100MHz Pentium Processor
- 8MB EDO Performance-Enhanced Memory
- 850MB 10ms DMA Mode 1 EIDE Hard Drive
- PCI Enhanced IDE Interface
- 32-Bit PCI Graphics Accelerator w/ 1MB DRAM
- 4X EIDE CD-ROM Drive
- 3.5" Diskette Drive
- 15" .28dp CrystalScan Color Monitor
- 7-Bay Desktop Case
- **104+ Keyboard** & MS Mouse 2.0
- **MS Windows 95**
- **MS Office 95, Professional Edition* with Bookshelf 95**
- **Gateway Gold Service & Support**

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P5-120

- Intel 120MHz Pentium Processor
- 16MB EDO Performance-Enhanced Memory
- 256K Pipelined Burst Cache
- **1GB 9ms DMA Mode 2 EIDE Hard Drive**
- PCI Enhanced IDE Interface
- 32-Bit PCI Graphics Accelerator w/ 1MB DRAM
- 4X EIDE CD-ROM Drive
- 3.5" Diskette Drive
- 15" .28dp CrystalScan Color Monitor
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- **MS Office 95, Professional Edition* with Bookshelf 95**
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P5-133

- Intel 133MHz Pentium Processor
- 16MB EDO Performance-Enhanced Memory
- 256K Pipelined Burst Cache
- **1GB 9ms DMA Mode 2 EIDE Hard Drive**
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While supplies last!

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- **MS Windows 95**
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- **Gateway Gold Premium Service**

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- Free Software Technical Support for all Gateway-provided operating systems & applications (includes Windows 95 Support)
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- Next Business Day Response On-Site Service†
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- Club Gateway™ Membership
- *GW2k™: Gateway Magazine*
- Gateway Bulletin Board (BBS) Service
- Automated FaxBack Service

†Pending parts delivery.

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International FaxBack Access 605-232-2561 • Component Add-On Sales 800-846-2080 • Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (CDT)

CODE TALK

RICK GREHAN

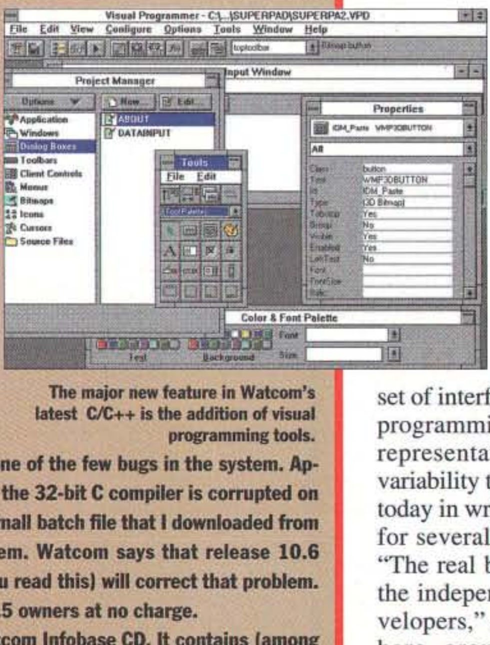
Watcom C/C++ 10.5 Gets Visual

Watcom C/C++ has many things programmers will like. But its integrated development environment is best described as spartan. Version 10.5 changes that with the addition of Blue Sky's Visual Programmer.

Watcom C/C++ 10.5 continues the compiler's tradition of multiplatform development support. Although it is still Intel-CPU-specific, Watcom C/C++ can create 16- and 32-bit applications for Windows, DOS, and OS/2. It can also create 32-bit AutoCAD applications and NetWare NLMs.

With 10.5, Watcom links the Visual Programmer into the compiler's integrated development environment. Visual Programmer provides rapid application-building capabilities, similar to those in Visual Basic, to C++. You build an application by defining windows, populating the windows with pushbuttons, scrollbars, and other elements, and attaching attributes and actions to the various objects. Visual Builder then generates MFC-based source code. As you build your application in Visual Programmer, it "back fills" the Watcom project with the appropriate files.

Watcom's previous version allowed you to regulate consumption of disk space by optionally keeping the help files on the CD; all other files had to go on your hard disk. With version 10.5, you can run most everything from the CD, freeing up lots of disk space at the expense of slightly slower execution. I opted for the "run from CD" choice at installation time (freeing up more than 30 MB) and collided with one of the few bugs in the system. Apparently, the executable copy of the 32-bit C compiler is corrupted on some copies of the CD-ROM. A small batch file that I downloaded from Watcom's BBS fixed the problem. Watcom says that release 10.6 (which will be out by the time you read this) will correct that problem. It will be available to version 10.5 owners at no charge.



Class: button
Text: WMF3DBUTTON
Id: IDM_Paste
Type: (3D Bitmap)
Tabstop: Yes
Group: No
Visible: Yes
Enabled: Yes
LeftText: No
Font:
FontSize:
Italic:

The major new feature in Watcom's latest C/C++ is the addition of visual programming tools.

Watcom has also added the Watcom Infobase CD. It contains (among other things) technical tips from Watcom's support hotline, faxline, and CompuServe forum. This enormous frequently-asked-questions file is basically a core dump of Watcom's Technical Support communications. Consequently, there's lots of non-C/C++ information on the CD.

Performance of generated executables (which is among the best) appears unchanged. I recompiled the BYTEmark benchmark using version 10.5 and ran the program on our baseline 90-MHz Pentium machine. The results varied by less than 5 percent from scores I obtained using a version 10.0-generated executable on the same machine.

Watcom C/C++ 10.5 is priced at $350; owners of previous versions can upgrade for $129; a competitive upgrade is $199. Contact Watcom (Waterloo, Ontario) at (800) 265-4555 or (519) 886-3700; fax (519) 747-4971; on the Web, http://www.watcom.com.

OPERATING SYSTEMS

Vendors Rally for 64-bit Unix

An impressive list of vendors has endorsed an initiative to develop a common 64-bit Unix API, but it may be two or three years before some vendors release compliant products. The list includes Intel, Hewlett-Packard, Silicon Graphics, Digital Equipment, Compaq, IBM, Novell, Oracle, SunSoft, and practically everyone else except Microsoft (which has Windows NT). Microsoft officials say that the NT file system is 64-bit for improved performance, but the company has not announced a 64-bit version of NT.

Unix vendors hope to define a set of interfaces and a 64-bit C programming model for data representation to reduce the variability that developers face today in writing an application for several versions of Unix. "The real benefactors will be the independent software developers," says Mark Silverberg, group manager, Unix product marketing for Digital Equipment (Maynard, MA). "If developers have a single specification they can program to, they won't have to develop or maintain different 64-bit implementations." Databases and other data-intensive applications will benefit the most from 64-bit operation.

The group says it will publish the 64-bit specification by the end of this year; it also intends to build from existing 32-bit APIs so that today's programs will run on future 64-bit operating systems. The API will also comply with existing standards such as XPG 4.2 (also known as the X/Open Spec 1170), POSIX, the System V Interface Definition (SVID), the Common Desktop Environment (CDE), and the X Window System.

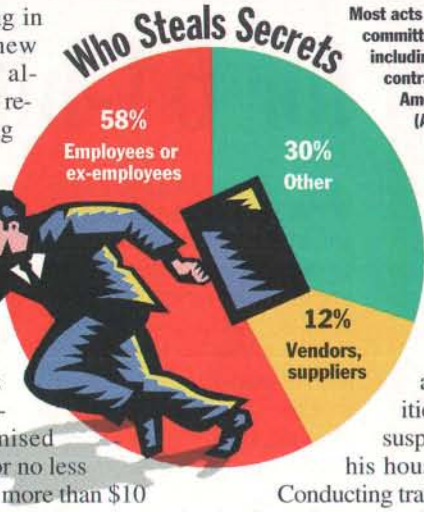
The 64-bit effort follows another attempt to unify Unix around the Common Operating System Environment, an initiative that achieved mixed results. "COSE was going to unify systems management and networking, and it didn't quite succeed in that," says Scott McGregor, senior vice president of products at the Santa Cruz Operation (Santa Cruz, CA). "But COSE succeeded in getting the Unix world, including Sun, to agree on Motif as the basis for the Common Desktop Environment. That alone is a tremendous success of COSE, and it's often forgotten."

The delivery of products that comply with the spec is up to each vendor. Companies such as Silicon Graphics, Digital, and HAL Computer already have 64-bit versions of Unix, and the amount of work needed for them to comply with the specification depends on how closely it matches current products. Others, such as SCO, don't currently have a 64-bit version of Unix. "SCO plans to ship a 64-bit OS coincident with Intel shipping the P7, which will be a 64-bit processor," McGregor says. "That's probably two to three years away from happening."

—Dave Andrews

SECURITY

Bank Robbers Go Electronic



Most acts against a corporation are committed with help from the inside, including employees, vendors, and contractors. That's according to the American Society for Security's (Arlington, VA) 1995 Intellectual Property Loss Survey.

Bank robbers are trading in their firearms for a new weapon: computers. And although companies are usually reluctant to admit embarrassing rips in security, Citibank (New York, NY), the banking division of Citicorp, has upgraded all security procedures following a breach of the bank's cash management system. In a series of break-ins, the bank's payment system was compromised (perhaps with inside help) for no less than the hack of the century: more than $10 million. (The bank says it eventually recovered most of that sum.)

Citibank is not the only bank to suffer from electronic burglary: Security expert Arnaud de Borchgrave estimates that in just two months this year, about $300 million dollars has disappeared, electronically, from U.S. banks.

In July 1994, Vladimir Levin, a mathematician in St. Petersburg, Russia, befriended a former St. Petersburg bus driver who had turned entrepreneur in San Francisco, according to recently unsealed court documents. Levin allegedly told his new friend he had found out how to wire-transfer money out of Citibank's computer system. Twice already, he allegedly bragged, he had squirreled substantial amounts into his own account in Finland. Court documents say Levin's colleague became a partner in what would become a multinational hacker ring.

Just a few weeks later, transfers were made to BankAmerica accounts held by Primorye (roughly translated as "Shoreland" in Russian) Corp. and Shore Corp., both of San Francisco. The companies were owned by Levin's friend Jevgenij Korolkov.

By this time, Citicorp officials had begun to suspect foul play and started questioning Korolkov. Korolkov left the country but apparently was not deterred. Instead, the two pressed on and recruited new partners around the globe, authorities say. By October 1994, 40 more transfers were made to California, Israel, Germany, Holland, and Switzerland.

Levin, who was system administrator at AO Saturn, a St. Petersburg software house, has been advised by his attorney not to speak to the press. But court documents allege he accomplished the illegal transfers by dialing into Citibank's cash management system. The system allows Citibank customers to initiate their own fund transfers to other banks; daily turnover is about $500 billion. Authorities say that to avoid causing suspicion, Levin dialed in from his house in Russia late at night. Conducting transactions during New York business hours would less likely raise alarms.

Levin apparently used valid user IDs and passwords of other banks, among them Banco del Sud in Argentina and Bank Artha Graha in Indonesia. How he got those passwords, given Citibank's extensive security, is unclear. Inside help seems likely, but Citibank claims that no employees were involved. Citibank officials declined to discuss their security procedures with BYTE, but a spokeswoman said that the bank continuously evaluates and improves its security measures.

According to Citibank, its security system flagged two August 1994 transfers, $26,800 and $304,000, as "strange." Bank officials called the FBI, who observed the electronic interlopers as they made their illegal transfers. U.S. officials were also assisted by telecommunications employees in Russia who helped track the illegal fund transfers to St. Petersburg, according to published reports.

Citibank claims it recovered most of the approximately $10 million in illegal transfers but says perpetrators were able to withdraw "less than $400,000" before other banks were notified and able to stop the transactions. Officials also say that at no time were any client funds at risk.

In March, Levin was arrested in transit at London's Heathrow airport. At presstime, he was fighting extradition to the U.S. from England. U.S. authorities want to try Levin on charges of theft, forgery, and computer fraud. Levin's attorney, Colin Reynolds, told BYTE that Levin wants to return to Russia. Five alleged accomplices in other countries, including Israel, the Netherlands, and the U.S., have been arrested.

—Udo Flohr

Whatever Happened to...

WEB Technologies' Amazing Compression? (see "Instant Gigabytes," June 1992, page 45)

In an announcement that sounded too good to be true, WEB Technologies (Smyrna, GA) claimed it had developed a compression algorithm that could squeeze almost any amount of data to less than 1024 bytes. The company claimed that its DataFiles/16 program could compress files larger than 64 KB to about one-sixteenth their original size. Skeptics said what WEB claimed was impossible, yet BYTE received numerous inquiries from readers, many of whom said they felt obliged to investigate WEB's claims, however implausible.

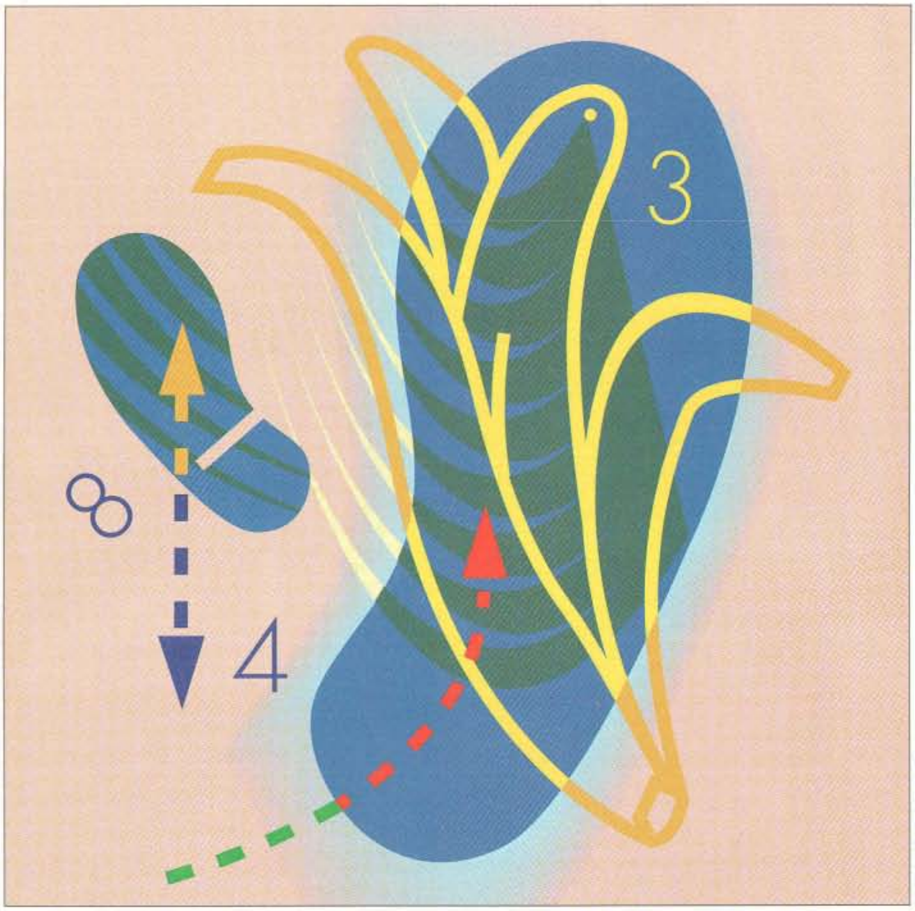
BYTE contacted WEB for a beta version of the software so that we could evaluate it. WEB at first declined to give us the beta, but we said we couldn't write a story about the product without one. WEB relented and sent us the beta version, which we tested and wrote about in the June 1992 issue.

Not surprisingly, the beta version of DataFiles/16 that reporter Russ Schnapp tested didn't work. DataFiles/16 compressed files, but when decompressed, those files bore no resemblance to their originals. WEB said it would send us a version of the program that worked, but we never received it.

When we attempted to follow up on the story about three months later, the company's phone had been disconnected. Attempts to reach company officers were also unsuccessful. WEB appears to have compressed itself right off the computing radar screen.

Kaboom, Inc.

CAREN D. POTTER



BILL FRAMPTON © 1995

So, one of your supertankers bellied-up on a reef and is now sliming Alaska? Or maybe another in a series of California earthquakes nuked your parking garage? Perhaps a network news show is dissing the trucks you make for inconveniently exploding on impact? Who ya gonna call? Failure Analysis.

Failure Analysis Associates answers nasty questions about nastier failures—by machines, buildings, and humans. Walk into their Menlo Park, California, headquarters (one of 11 facilities nationwide) and you'll be tripping over scientists and engineers brandishing Ph.Ds from MIT and Stanford. Computers are everywhere. More than 1000 personal computers (laptops, Macs, and PC clones) and Silicon Graphics workstations help slake the processing needs of the 400-plus employees. Digital Equipment minis and IBM maxis hold more than 60 databases containing such tidbits as 350 million accident and incident records, as well as handy items such as a copy of every U.S. death certificate since 1975.

The company acquires software by the "one of each" method: If there are five programs, each a little better than the others for a certain type of problem, Failure Analysis probably has them all. Perusing the typical office bookshelf turns up numerous software manuals, and not just for word processing and running spreadsheets—structural stress–analysis packages and human body–modeling programs are just as likely.

When technology goes splat, Failure Analysis sends in a squad of detective engineers wielding heavy-duty computer wizardry

The firm's Phoenix, Arizona, desert test facility is a Disneyland of disaster that includes a two-mile road track (festooned with your basic potholes, railroad crossings, and water-filled ditches), a 1200-foot crash rail that can send a vehicle smashing into a wall (or another vehicle—your choice) at up to 90 mph, a 90-foot drop tower, and a ballistics range just right for blowing things up. What more could a catastrophe-minded techie ask for?

Failure Analysis CEO Roger McCarthy estimates that the company has invested nearly $30 million in technology, and the company spends some $3 million annually keeping it all up-to-date.

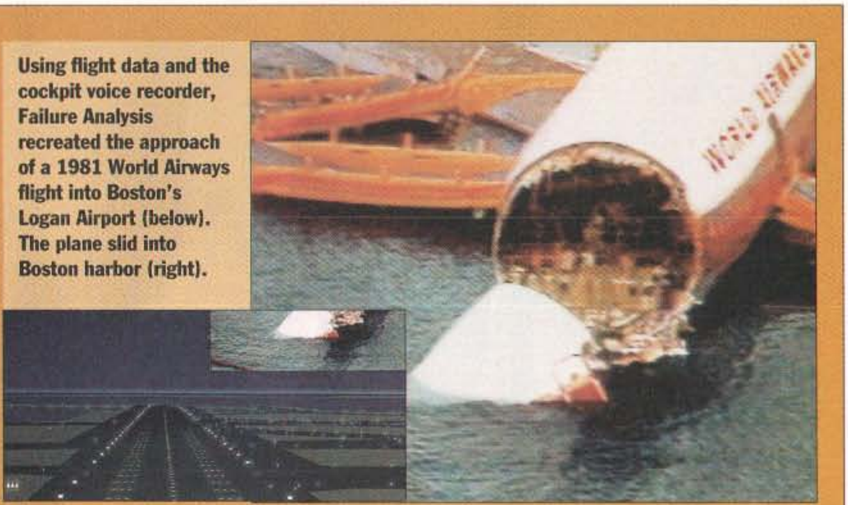
Why the tech-fest? Technology helps supply the missing (or disintegrated) pieces. "We're often called in years after an accident has happened," explains Garrison Kost, head of vehicle accident reconstruction. "By that time, the site may have changed, vehicles may not be available. We collect all the evidence we can, then use technology to fill in the gaps in our knowledge."

Calamities of the Rich and Famous

Failure Analysis has been called in on many high-profile cases. When *Dateline NBC* showed a car plowing into the side of a GMC truck with side-saddle gas tanks, a made-for-TV collision that produced a dramatic fireball, General Motors got suspicious. GM scored a major PR body-slam when Failure Analysis showed, using computerized video enhancement (and searching dozens of junkyards to find the actual vehicles), that puffs of smoke appeared a fraction of a second *before* the collision. NBC had rigged the truck with rocket motors to ensure it exploded telegenically. The network wound up eating on-air crow to forestall the libel case of the century.

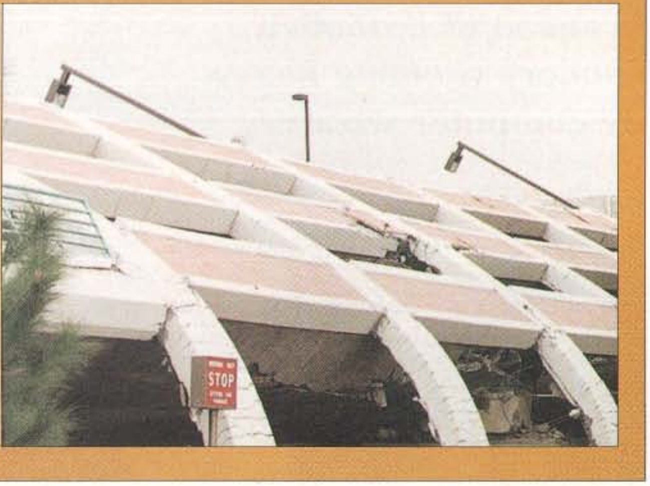
Conspiracy fans were paying avid attention when Failure Analysis reexamined some of the JFK assassination evidence for the American Bar Association's mock trial presentation, "The United States v. Lee Harvey Oswald." The company showed that an assassin on the sixth floor of the Texas School Book Depository could have committed the murder alone.

Owners (and insurers) of property damaged in the 1994 Los Angeles earthquake hired Failure Analysis to determine the extent of the damage. Following extensive and hazardous field work, and computer simulation of building behavior, the company could make useful recommendations about whether buildings should be repaired or trashed.



Using flight data and the cockpit voice recorder, Failure Analysis recreated the approach of a 1981 World Airways flight into Boston's Logan Airport (below). The plane slid into Boston harbor (right).

In 1988, a series of explosions, the largest one exceeding the equivalent of 1.5 million pounds of TNT, destroyed a chemical plant in Henderson, Nevada. Two people died, and the surrounding community suffered more than $70 million in damages. Failure Analysis determined that the explosion was due to a leak in a natural-gas line under the plant.



On January 17, 1994, an earthquake measuring 6.6 struck the Los Angeles area, causing more property damage than any earthquake in U.S. history. This parking structure was one of the more artistic casualties Failure Analysis investigated.

How James Dean Died

Failure Analysis's re-creation (commissioned by the TV show *What Happened?*) of James Dean's fatal car crash 40 years ago is a good example of the puzzles the company pieces together. Without much to go on, Failure Analysis used computers to reconstruct the event as a three-dimensional animation and eventually fingered the driver at fault and showed how fast each car was going when they collided.

Dean, accompanied by his mechanic, was driving his Porsche Spyder from Bakersfield toward Monterey, where he was going to race the car. It was a clear day. At 5:45 p.m., on a straight stretch of two-lane asphalt road, where U.S. 41 and U.S. 46 intersect, Dean's westbound car collided with an eastbound Ford. Dean was killed and his passenger suffered broken bones, but the driver of the Ford had only minor injuries. What happened?

James Dean's live-fast, die-young reputation suggested an open-and-shut case: His speeding and recklessness must have been to blame. But strangely, as Failure Analysis started scrutinizing the accident, this hypothesis didn't hold together. "Damage to the vehicles didn't indicate an extremely high-speed collision," says Kost.

The steps in reconstructing this accident are typical of Failure Analysis investigations, according to Kost. (An investigation can cost anywhere from $5000 to $50,000, depending on the complexity of the accident—double that if you want computer animations. The Dean case cost an estimated $50,000, but those findings were intended for a TV audience, not a courtroom.) First, the analysts collected whatever information they could: the original California Highway Patrol report, statements from two people in a car following the Ford, a few photos of the road and vehicles after the accident, roadway "as built" drawings, and three aerial photos of the site taken the same year as the accident. Not much to puzzle out the truth.

The next step was creating computer models of the vehicles, their paths, the scene, and the surrounding terrain. Lacking the actual vehicles, Failure Analysis digitized two "exemplar" vehicles—twins of those mangled in the accident—using a theodolite, a computerized surveying tool that automatically records *x*, *y*, *z* coordi-

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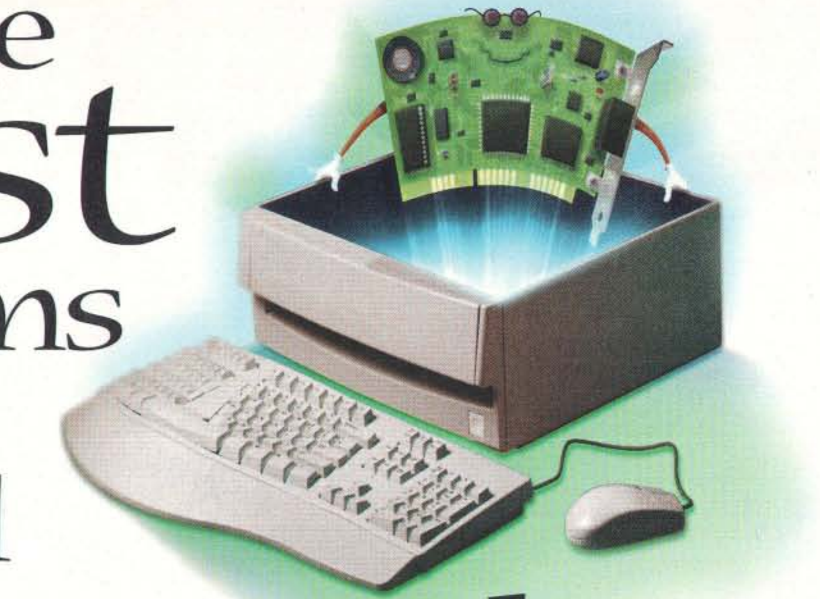

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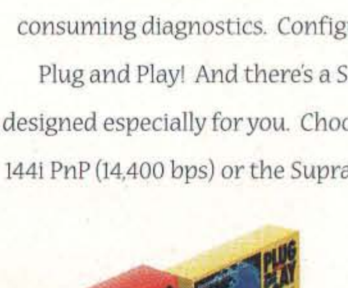

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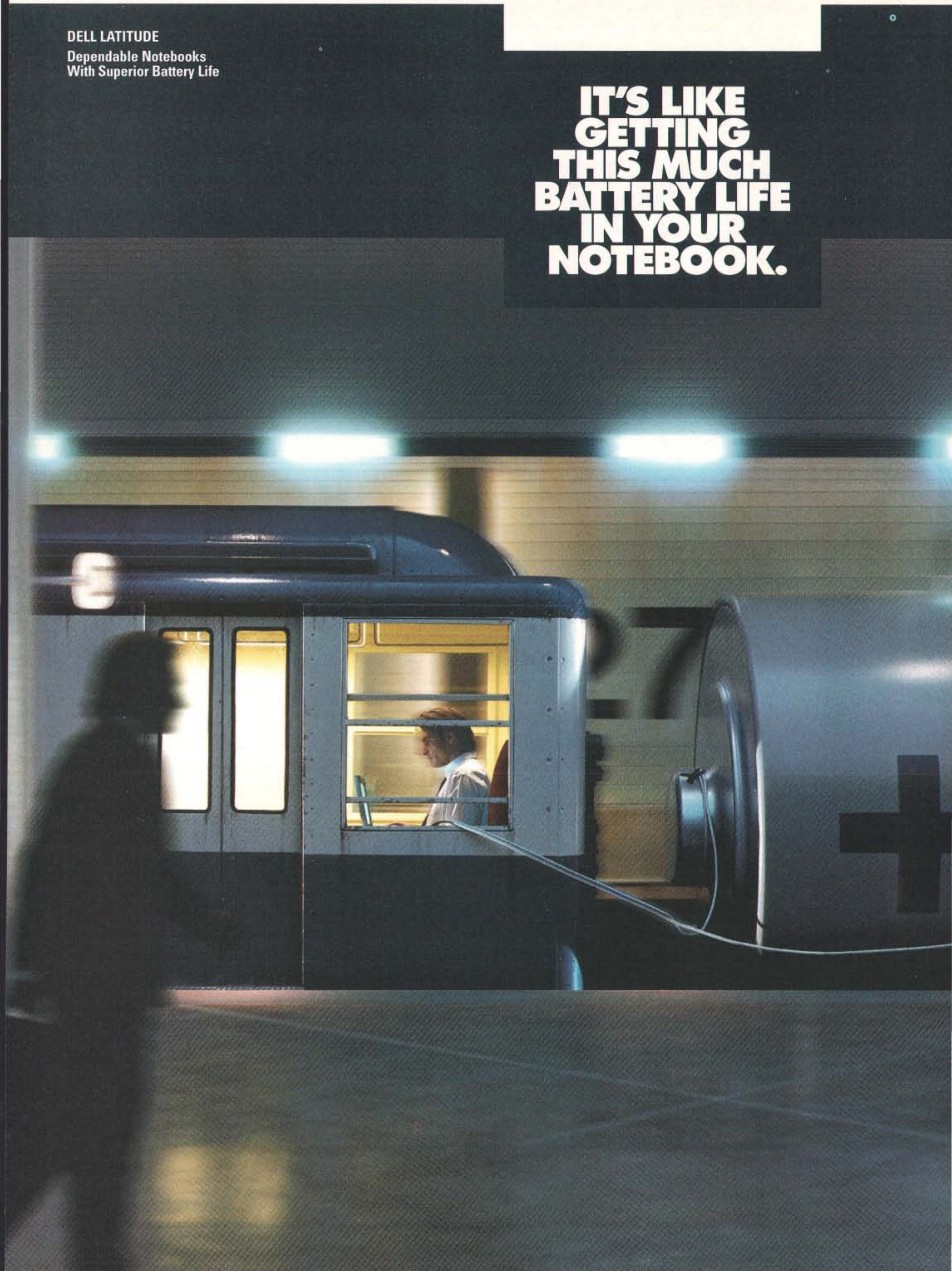
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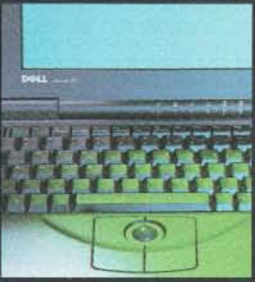

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intel inside pentium PROCESSOR

Designed for Microsoft® Windows®95

nates of an object in AutoCAD-standard DXF format. The company's theodolite gets a lot of exercise, as does the publication *Auto Trader*: It's a good way to find exemplar vehicles, which Failure Analysis buys whether they run or not.

Wavefront's Advanced Visualizer high-end visualization software, which Failure Analysis runs on Silicon Graphics workstations, imported the sketchy vehicle information in the DXF file. Applying surfaces, textures, and colors to the digitized points resulted in photo-realistic 3-D computer models of the Ford and the Porsche in the accident, right down to details such as the race numbers on Dean's car.

Collisions by Computer

Failure Analysis pored over vehicle publications of the time, gleaning particulars such as: The Ford weighed 3000 pounds, significantly outweighing the 1400-pound Porsche. This news, along with vehicle esoterica (such as tire properties and crush stiffnesses), descriptions of the road surface, apparent point of contact, and the final resting positions of the two vehicles, was dumped into the hopper of Engineering Dynamics Corp.'s Simulation Model of Automobile Collisions program (EDSMAC). Using principles of mechanics, this PC-based package could determine the trajectories of the vehicles after the collision, as well as the damage to each vehicle. The laws of physics, after all, apply even in California, and even to James Dean.

The engineer tried out different combinations of speeds and angles, allowing the vehicles to crash on-screen many times, until the vehicles ended up in just the right positions and the simulated damage matched that of the actual cars (as preserved in photos). Guessing high speeds for Dean's car caused the simulated vehicle to overshoot its actual point of rest. (See the figure "Post-Impact Trajectory—V1 Porsche" at right.) When the simulation best duplicated the actual events, Dean's car turned out to be going only a modest 57 mph, while the Ford's speed was 55 mph. So much for the speed-demon theory.

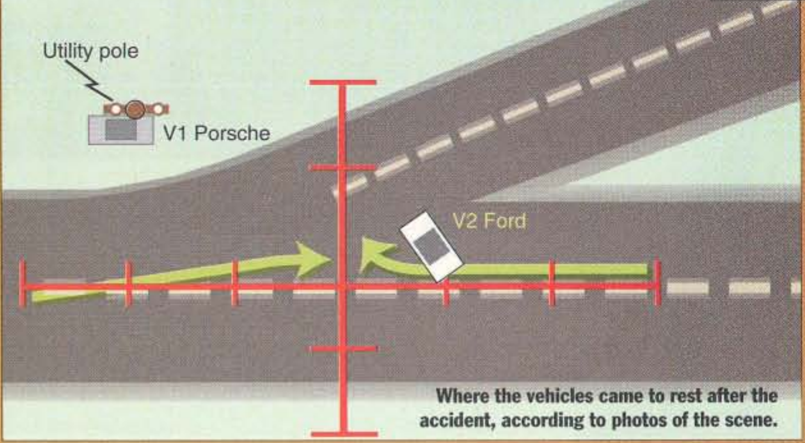
With the right vehicle speeds, EDSMAC can spit out position and velocity for each time step in the simulation: just the data Wavefront software needs to generate motion paths for an animation.

They also re-created the accident scene, using Wavefront, to make the presentation look more realistic. Theodolite measurements again marked the exact 3-D locations of the two intersecting roads, their center lines, telephone poles, and other landmarks, which were fed into AutoCAD as the basis for creating a 3-D plot of the

Simulation of James Dean's Fatal Crash

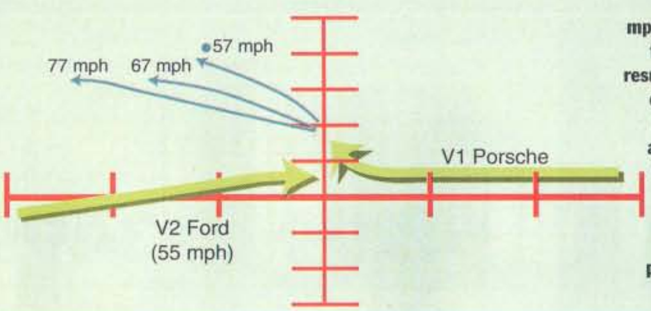
UPI / BETTMANN

Post-Accident Point of Rest

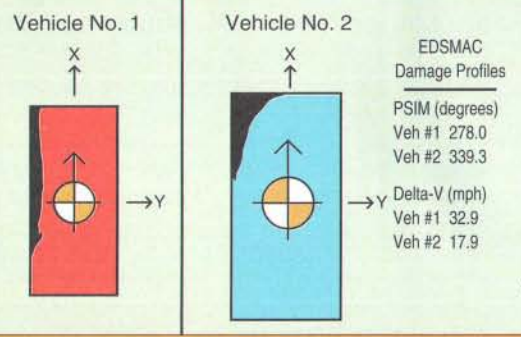


Where the vehicles came to rest after the accident, according to photos of the scene.

Post-Impact Trajectory – V1 Porsche



EDSMAC simulations using speeds of 77 mph and 67 mph for Dean's car resulted in points of rest beyond where the car actually ended up. According to the simulation, Dean was probably going 57 mph.

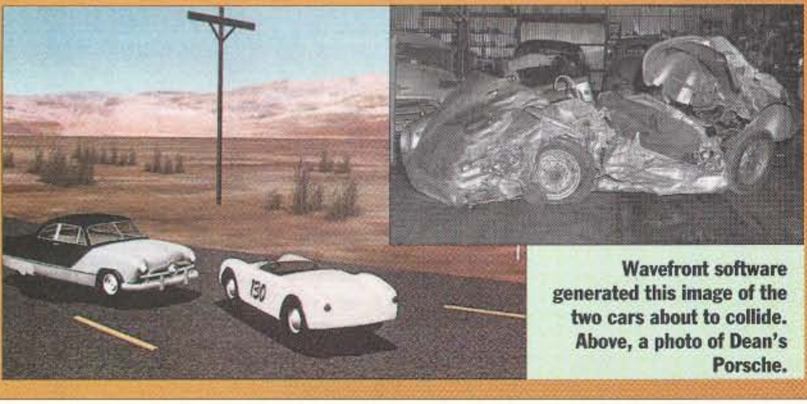


EDSMAC Damage Profiles

PSIM (degrees)
Veh #1 278.0
Veh #2 339.3

Delta-V (mph)
Veh #1 32.9
Veh #2 17.9

In an EDSMAC damage profile, vehicle damage is represented by darkened areas. (Dean's Porsche is Vehicle No. 1.) PSIM refers to the orientation of the midpoint of vehicle damage. Delta-V is the change in velocity at the point of impact. While EDSMAC's graphics lack flash, its calculation capabilities were critical to this investigation.



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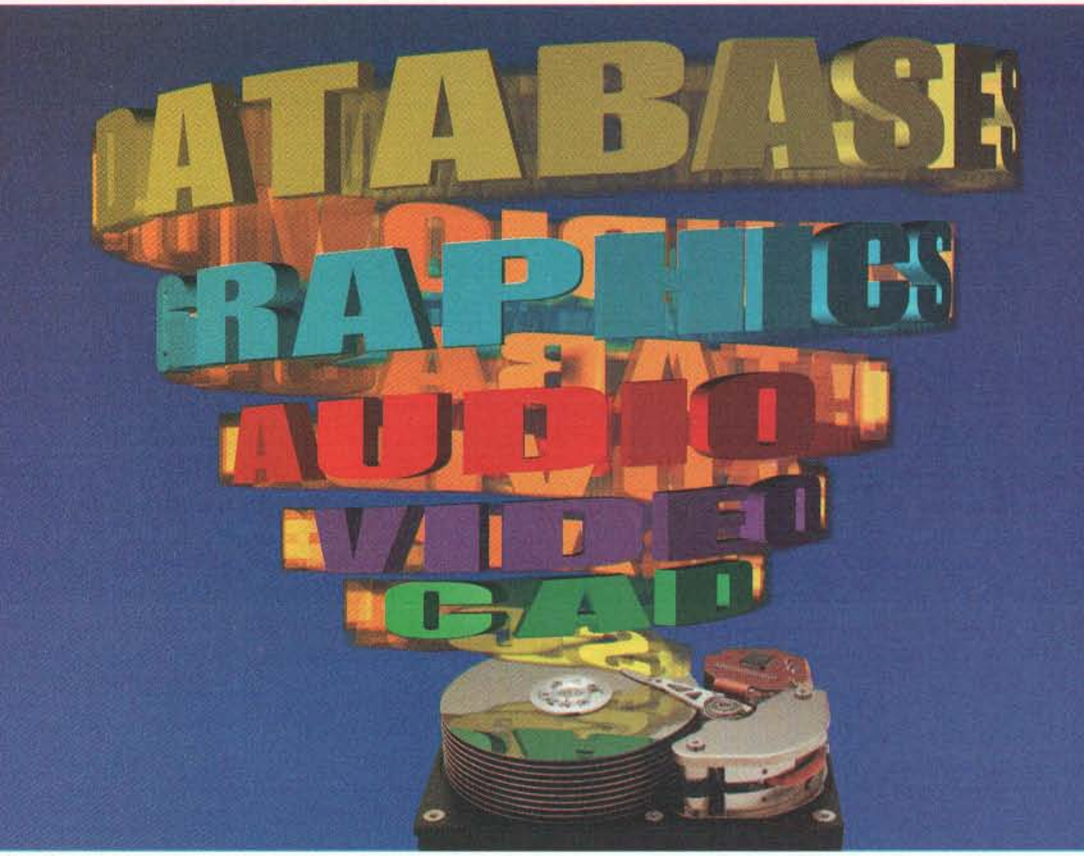
Wavefront software generated this image of the two cars about to collide. Above, a photo of Dean's Porsche.

Performance by Conner.



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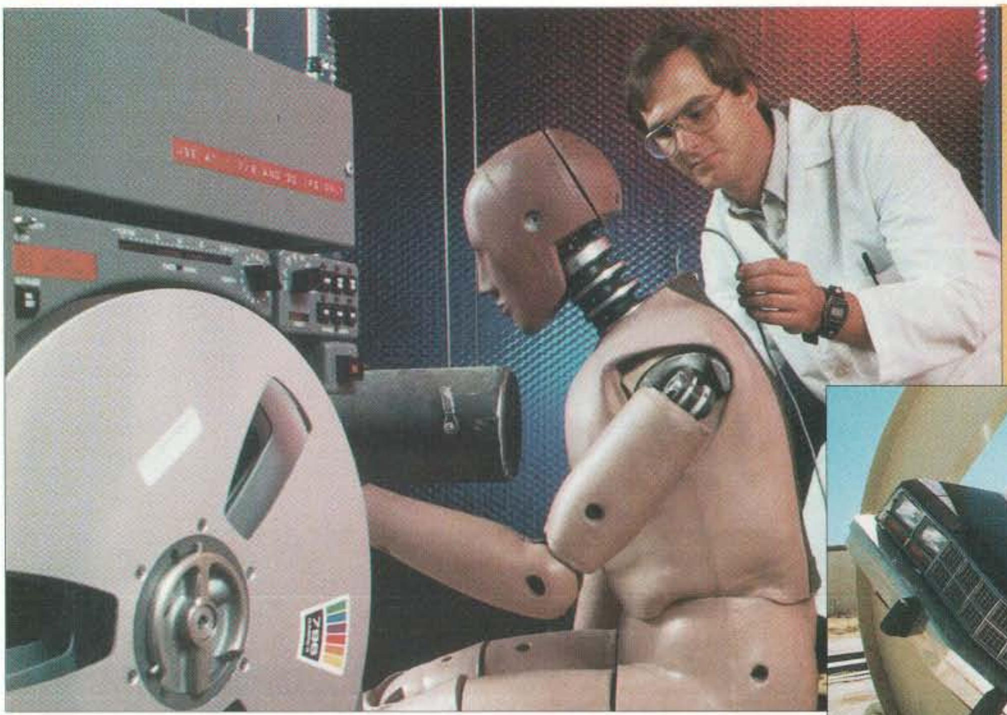
Circle 114 on Inquiry Card.



◀ **Data obtained from instrumented anthropometric dummies is used to assess injuries and compare different accident situations.**

▼ **Engineers at Failure Analysis's Test & Engineering Center in Phoenix use this static roll-over device to turn a car 90 degrees for evaluations of fuel-system integrity. The device can also turn a car completely over for studies of occupants during rollovers.**

scene. This plot ensured that the animation was scaled precisely. A photograph of the scene was applied as a texture map to give a near photo-realistic look.

Better Than Film at 11

The fruit of all Failure Analysis's labor was a 45-second 3-D animation of the accident, from many points of view. (See the still image on page 48NA 6.) One of the many benefits of using computer animation, as opposed to a video re-creation, for instance, is that the "camera" can be placed anywhere: in the car following the Ford, in the Ford's driver's seat, even showing what Dean himself might have seen. While the spectacle isn't gory—no cars crumpling or glass flying into the air—it certainly does make clear what actually happened. Dean wasn't speeding excessively. Neither was the driver of the Ford. That driver made a bad judgment and turned left in front of Dean.

The Science of Uh-Oh

Far more of Failure Analysis's work appears on the witness stand than on the TV screen. Typically, a company being sued, or its insurance carrier, hires Failure Analysis to perform its own independent investigation and testify as an expert witness. The analysts usually bring some supporting visual aids: a graph of a computer analysis, or, as in the Dean case, a full-blown computer animation.

Computer animations are so convincing that a judge might disallow them, thinking their realism could confuse the jury into thinking they portray actual events. Nonetheless, they are usually admitted as evidence since part of the job of the Failure Analysis witness is to convey the science that went into making the animation accurate. "We only use computer animation when we need to get across a sense of the time or a complicated sequence of events," says Kost. "Or, to show the point of view of the driver, to illustrate what he could or could not see."

Because accidents often tragically involve human injury or death, Failure Analysis also has biomechanical engineers who specialize in assessing injuries. These engineers use simulation software running on Silicon Graphics workstations to evaluate injury-producing forces acting on the body. Packages such as TNO's MADYMO (Mathematical Dynamic Modeling) estimate loads on the human body using vehicle motion and the geometry of a vehicle's interior. They can, for instance, calculate if the force in a collision is enough to justify claims of whiplash.

Ironically, the same sophisticated technology that helps make the world safer will almost certainly be misused by the luckless and the clueless. "Technological sophistication has the potential to make failures and accidents less likely, because the computer can second-guess you," CEO McCarthy says. "But at the same time, there will be an increasing number of people who don't understand the total system implications of what they're doing. In 20 years, Failure Analysis will be in the business of solving increasingly technological and system-related issues, such as Three Mile Island and similar control failures caused by people who didn't understand technology."

And that's why their business will probably continue booming. ■

Caren D. Potter is a freelance writer who lives in McKinleyville, California. You can reach her on the Internet by sending E-mail to cpotter@northcoast.com.

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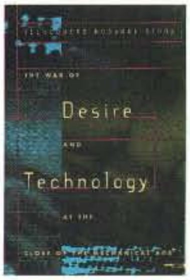


JOHN MONTGOMERY

The War of Desire and Technology at the Close of the Mechanical Age by Allucquère Rosanne Stone is exactly the kind of book you'd expect to find the word *hermeneutics* in. It's also the kind of book in which you'll find the word *s***head*. Between strings of obscure words and captivating stories, you'll discover a philosophical analysis of what it is to interact with other people in our increasingly digital world.

Stone employs several writing styles, ostensibly in an attempt to echo the confusion of a digital culture. It's a little like reading an article from *Esquire* right after one from the *Journal of Sociology Nerds*: a bit startling but invigorating. But Stone is at her best when telling stories. Her recounting of the trial of a man accused of raping one of the personas of a woman with multiple personality disorder is interesting, enlightening, and dramatic.

Throughout the book, though, she resorts to academic prose. One example is in her description of how a customer of a phone-sex service will supply missing information (e.g., how a partner looks) with idealized fantasy. Her explanation goes on for nearly two pages and says nothing more than that people who listen to phone sex use their imaginations. Surprise.

The book concludes with an attempt to draw together these diverse styles: "In this brief time of upheaval and promise that always accompanies the transition between modes of experience and thought ... there is a window of opportunity to transform the way academic discourse in the humanities and social sciences works." After making this point, Stone goes off on a peculiar extended metaphor—that of the vampire Lestat as anthropologist. Hmmm.

There are a few wonderful stories in *The War*, but there are too many places, particularly in the beginning, where it's just too easy to put it down and reach for your worn copy of *Neuromancer* or *Snow Crash*. These pieces of fiction relate most of what Stone is trying to convey far more effectively and memorably.

THE WAR OF DESIRE AND TECHNOLOGY AT THE CLOSE OF THE MECHANICAL AGE

Allucquère Rosanne Stone
MIT Press
ISBN 0-262-19362-0
$22.50

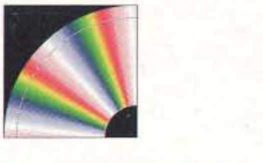
John Montgomery, who is located in BYTE's San Mateo office, heads the features department. He can be reached on the Internet or BIX at jmontgomery@bix.com.

YES, YOUR PC HAS A MIND

ARTIFICIAL MINDS by Stan Franklin **MIT Press, ISBN 0-262-06178-3, $35**

Will your computer ever have a mind? After reading *Artificial Minds* by Stan Franklin, I believe the answer is clearly: You're asking the wrong question. At the very beginning of Franklin's genial "tour," he sets out seven propositions he intends to illustrate. Because these include "mind is better viewed as a continuum rather than a Boolean notion" and "mind, to some degree, is implementable on machines," the outcome of the story is never in doubt. However, as a good storyteller, Franklin makes the journey both entertaining and educational.

He's prepared a hearty smorgasbord, with dishes drawn from many fields. I went light on the neurons and ganglia, merely sampled the semantics, but I took large helpings of mathematics, physics, and robotics. You'll also encounter AI, Turing machines, Schrödinger's cat, Gödel's theorem, genetic algorithms, artificial life, chaos theory, and legions of robots. Although it's written for the nonexpert, there's plenty to interest professional researchers. ■ **—Edmund X. DeJesus**



ANIMAL BEHAVIOR

EYEWITNESS ENCYCLOPEDIA OF NATURE
Dorling Kindersley Multimedia, 95 Madison Ave., New York, NY 10016, (212) 213-4800, $54.95

HOW ANIMALS MOVE **Maris Multimedia/The Discovery Channel, 100 Smith Ranch Rd., Suite 301, San Rafael, CA 94903, (415) 492-2819, $49.95**

For most people, getting back to nature means cutting the lawn. These CD-ROMs offer an alternative for those of us who want a little more adventure yet are not inclined to desert safaris or underwater diving expeditions.

Eyewitness Encyclopedia of Nature requires Windows 3.1. It transports you to a virtual biological library, where you can explore everything from the savannas of Africa to the world beneath a microscope. The interface consists of books, posters, and specimen drawers that offer links to a number of organisms. By selecting a direction on a compass or coordinates on a sextant, you can explore the habitats and environments in which these animals live. The CD-ROM also includes a detailed time line, an extensive search tool, a useful help section, and a quiz that asks related questions at various difficulty levels.

How Animals Move requires Windows 3.1 or Mac System 7.0. This CD-ROM is meant for a preteen audience. It offers 11 guided tours through various methods of animal motion, including running/walking, burrowing, swimming, and gliding. Tours include short video examples of animals moving by land, air, or sea.

The simple-to-use interface also links to a game page, where you can choose from four categories: interactive graphs, experiments, simulations, and games. One interactive graph lets you control the jump of a kangaroo by adjusting air density and slope. A walking-and-running experiment calculates times and the energy used by runners over various distances. An interesting simulation lets you control the swing of a gibbon monkey.

If you're daring enough to go beyond the outdoor mowing experience, these two CD-ROM titles might provide just the thrill you're looking for.

—Jeff MacClay

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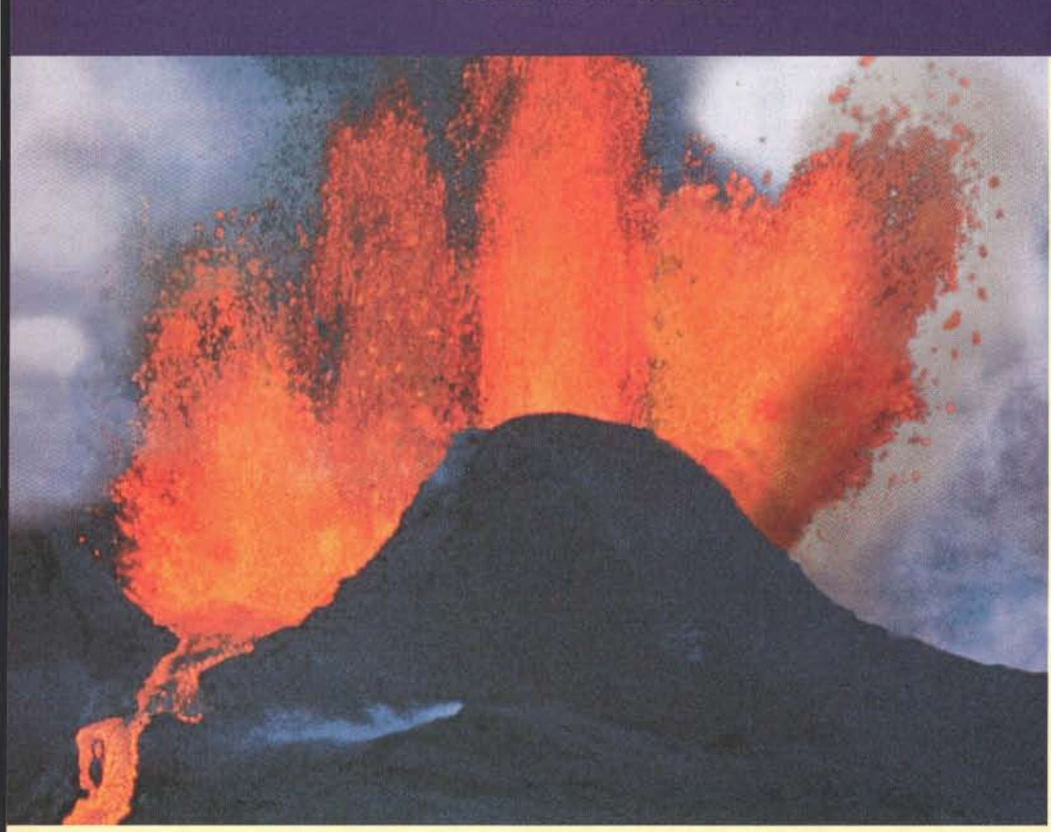

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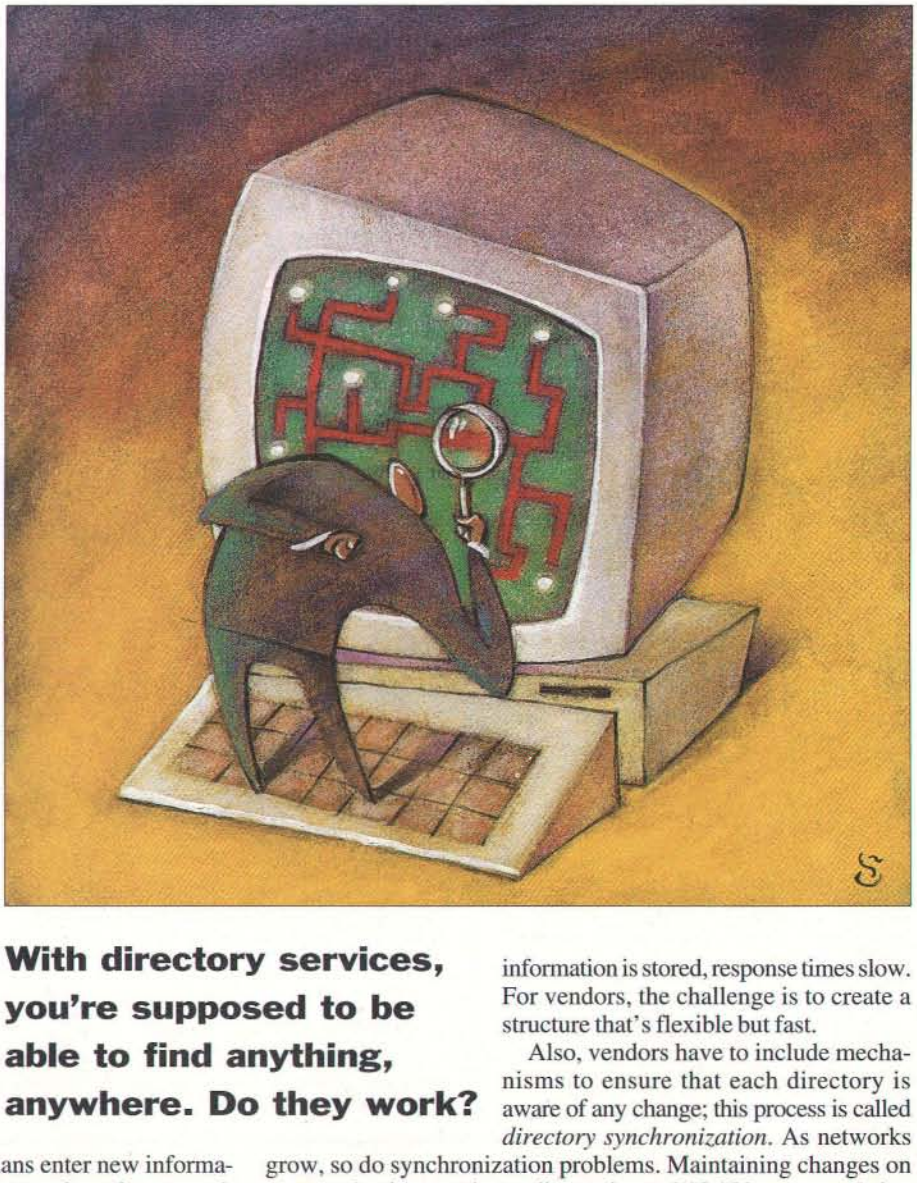
Needle Hunting

PAUL KORZENIOWSKI


RICHARD STEADHAM © 1995

A network is a haystack. The printer you want to send your file to is a needle. If the haystack has two or three straws, no problem. But have you ever seen a pint-size haystack?

The key to needle hunting lies in an effective directory system that can locate and identify users, servers, files, and other resources. But it's not simple—the problems with administration and synchronization alone often appear insurmountable, and competing standards form another haystack as nightmarish as your network. The solution may lie with the ISO's X.500 specification. But until X.500 gains more acceptance, you're left with directory systems that often weren't designed to handle the load they carry.

The Administrative Nightmare

Many users never get beyond their own network's neighborhood and don't realize there's a problem. For them, everything works fine. Not so for the network administrators, who maintain the directories that store user names and addresses in flat-file structures or DBMSes. As users join, leave, or move, each change requires a directory update.

With directory services, you're supposed to be able to find anything, anywhere. Do they work?

With networks growing, the number of directories has also skyrocketed, and manually monitoring a dozen or more directories is time-consuming, impractical, and prone to error. There's also a time lag. In many organizations, technicians enter new information only weekly or monthly. Until the next update, the network is vulnerable to security breaches.

Most companies want to automate the updating process, but automation raises complex technical problems and trade-offs. "Directories are one of the most difficult issues to solve because they touch applications, networks, and users," notes Aaron Con, a product manager for Microsoft Exchange (Bellevue, WA).

What's in a Name? Or a Directory?

Most companies want at least one global directory of all users, plus smaller directories throughout the network. How much global information should be stationed in the remote directories? As more information is stored, response times slow. For vendors, the challenge is to create a structure that's flexible but fast.

Also, vendors have to include mechanisms to ensure that each directory is aware of any change; this process is called *directory synchronization.* As networks grow, so do synchronization problems. Maintaining changes on a network with two dozen directories and 10,000 users can bring the system to its knees.

What's worse, today we rely on directories for sophisticated tasks such as network security. Consequently, they need to be flexible enough to support a wide range of uses.

"The major issue companies face with networks is cost of ownership," says David Eckert, the NetWare Directory Service (NDS) product manager at Novell. "Without robust directory services, a technician can service only 100 or so users. With robust services, he can handle 500."

The Gallup Organization (Lincoln, NE) supports 2000 users worldwide. In 1992, the company began to build a WAN. Tim

X.500: THE ONCE AND FUTURE ANSWER

In the mid-1980s, the ISO began outlining X.500, a standard that builds directories on distributed databases so that companies can divide their networks into distinct domains. Information is passed between domain servers in a hierarchical manner.

The first standard, completed in 1988, lacked needed features, such as replication. Also, X.500 was rigid, requiring addresses defined in a fixed manner: country, company, organizational unit, and locality information. By the time X.500 came into existence, many firms were reluctant to discard existing addressing schemes.

Also, the standard was designed to work with X.400, a lower-level E-mail standard, and it didn't work easily with other types of mail systems.

A 1992 version of X.500 includes replication facilities, so multiple copies of a global directory can be kept on different machines. Users now have the flexibility to customize addresses.

Problems may arise because the current specifications are broad and vendors have a lot of latitude. There are no accepted APIs that outline how to move information from one X.500 system to a second.

A directory system includes a list of such mailing addresses as well as the software needed to move it from one location to the next. X.500 has a hierarchical directory structure and global information; instructions are stored in a global Directory Information Tree (DIT). This information is then broken up and spread to different directories, dubbed Directory System Agents (DSAs), through a network via a Directory System Protocol, which lets directories exchange information.

The Directory User Agent (DUA) is client software that presents directory options to a user. A DUA then accesses the nearest DSA via a Directory Access Protocol (DAP), which connects a user to a directory system. DSAs then exchange information so the user can either transmit a message or locate a mailing address.

Gilkerson, Gallup's director of worldwide network operations, says the organization examined Banyan Systems' Vines and NetWare. "We determined that Vines was easier to maintain and required fewer technicians than NetWare."

Then, NetWare supported only simple directory services with its bindery, which stored addressing information on one stand-alone server. A technician had to relay each change to all network directories. Banyan's StreetTalk directory service automatically transmits changes to servers.

With distributed directories, a user can walk up to any machine on a network, enter a password, and begin working. With stand-alone directories, users can access information only when they are connected to a particular server. "Many employees travel, so we wanted to make it easy for them to work on the road," Gilkerson says.

Banyan is offering directory services to NetWare users, and Novell is trying to catch up. With NetWare 4.0, the company added a robust global-naming service. Novell's Eckert notes that the service lets technicians divide directories however they wish.

Microsoft has been well behind the other network OS (NOS) vendors in terms of directory services. It offers a rudimentary directory with Windows and plans to add global capabilities with the Cairo release of Windows NT, scheduled for next year.

Directing E-Mail

E-mail suppliers have developed sophisticated directories. Gallup users work with Lotus's cc:Mail and its directory services as well as with StreetTalk. "When we installed our network, cc:Mail was the only robust mail package running on Vines," Gilkerson explains.

The Lotus product features Automatic Directory Exchange (ADE), which automatically updates all cc:Mail user addresses. Two years ago, Pathfinder (Waltham, MA) migrated from stand-alone PCs to a NetWare LAN and selected cc:Mail. "Many employees work in third-world countries, so we needed a mail system that supported a variety of transmission types," notes John Talbot, systems manager at Pathfinder. Managing updates to 15 remote directories is simple; ADE automatically transmits each new entry to all locations.

Microsoft Mail 3.0 got distributed-directory capabilities in 1992. It updates E-mail systems, gateways, and personal directories at programmable time intervals.

Multivendor, Multiproblem

The Lotus and Microsoft products keep their own directories in sync. But many companies have multiple E-mail systems to synchronize. Unfortunately, many vendors designed incompatibilities into their directory services. One product may support addresses with three fields of eight characters each, while a second works with four 10-character fields.

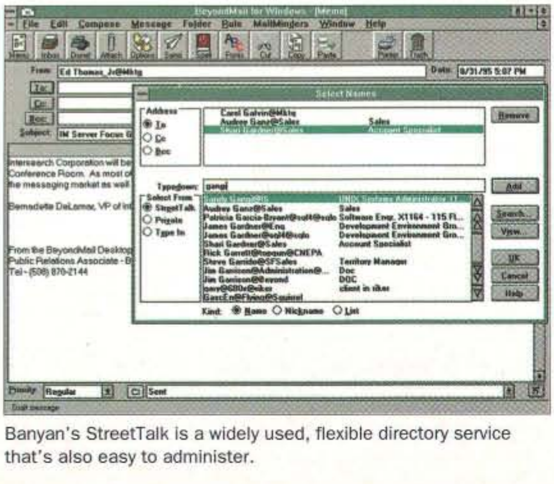
One way to solve this problem is open APIs, as with cc:Mail and Microsoft Mail. Users and third parties can then design translation programs. But few corporations are willing to take on this job. "A company we work with supports 23 different mail systems, so it's looking for ways to minimize directory management rather than take on new chores," notes Con.

These companies turn to third-party tools. For example, Soft*Switch's (a division of Lotus) Directory Synchronization Protocol (DS/P) translates directory information among Banyan, Digital Equipment, IBM, Lotus, Microsoft, Verimation, and Wang Laboratories mail systems.

Most directory-exchange programs offer only the least-common-denominator function set. For instance, one directory system may support authentication, but the synchronizing software doesn't. The result? Good-bye security.

At Prudential Insurance (Roseland, NJ), 50,000 users work with Digital's All-in-1, IBM's OfficeVision, Lotus's cc:Mail and Notes, Microsoft Mail, and Novell's MHS mail systems. Prudential had been seeking a directory-synchronization system since the early 1990s, says Randi Mather, an associate systems manager. In 1993, Prudential began testing Lotus's Enterprise Messaging Exchange (EMX). The company found it flexible enough to synchronize Prudential's many mail systems and put it into service in 1994. EMX sends between 100 and 500 administrative and address changes through the system each day. "Since EMX was introduced, Lotus has delivered add-on modules, which have made management of our mail systems simpler," Mather notes.

continued



Banyan's StreetTalk is a widely used, flexible directory service that's also easy to administer.

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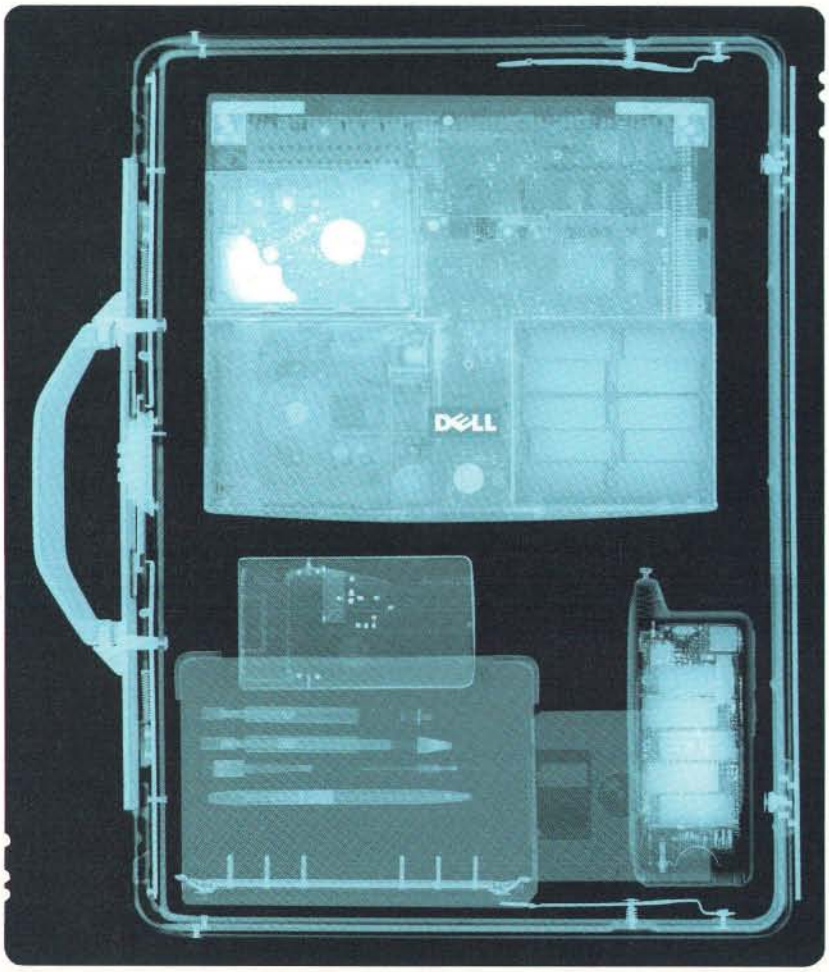

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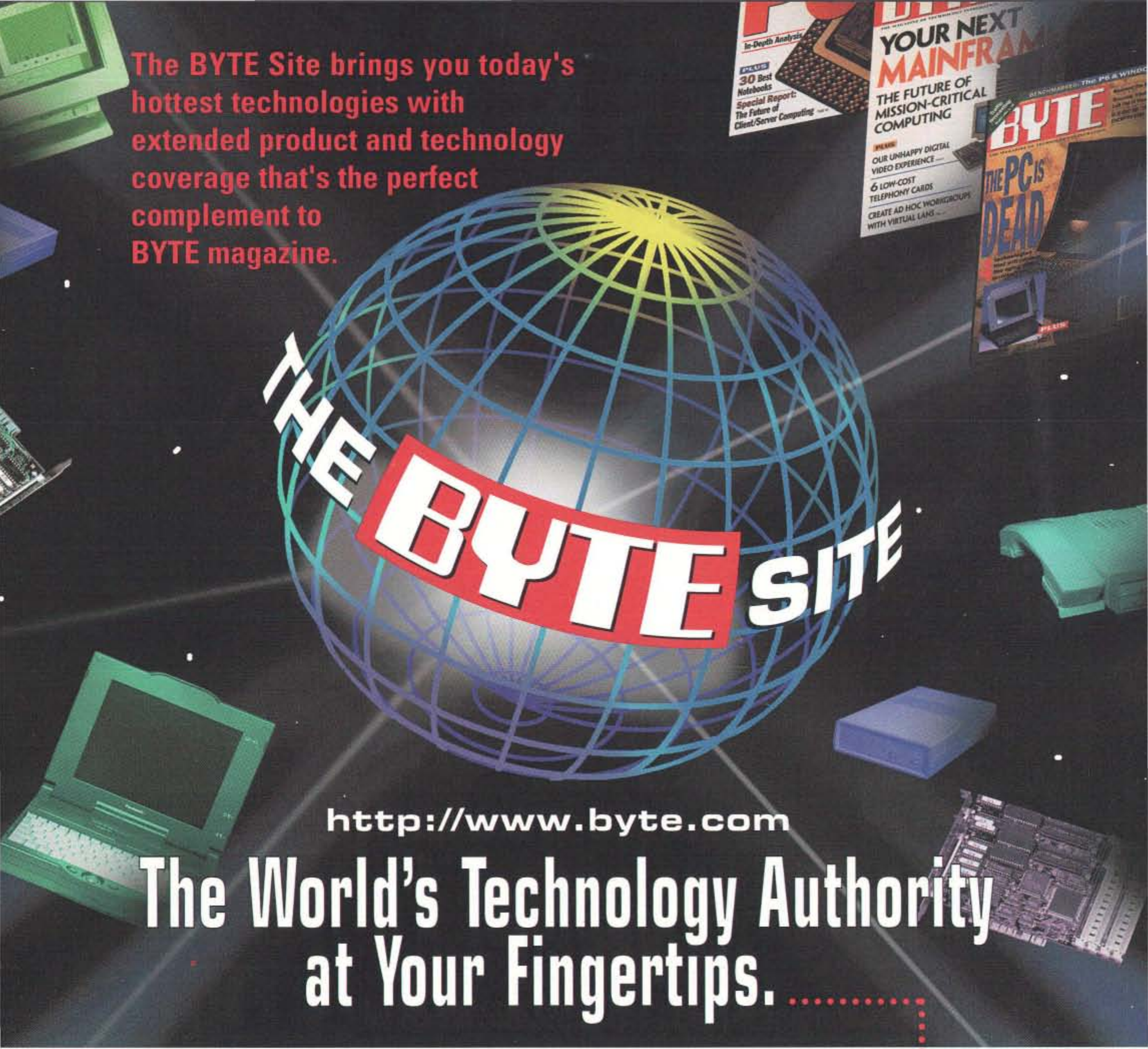
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What Kind of Directory?

EMX is geared only to E-mail systems, so users must maintain other directories. "A LAN OS houses one directory, a mail system has a second, and the phone system operates a third," says Rapport Communications' Dan Blum. "They're all growing, so management is becoming more difficult. Long term, companies want to consolidate all their directories into a single system."

Tips for Managing Multiple Directories

- **Identify how many directories there are in your organization.**
- **Determine how much addressing information is duplicated in the directories.**
- **In the short term, identify the vendor that has the most directory links with your current configuration and begin using its tools to consolidate directories.**
- **For the long term, start learning about X.500 and ask vendors their X.500 support plans.**

Consolidation would ease software development as well as user administration. Applications developers often have to build their own directory services. "Developers would prefer to focus on applications features, not basic networking items such as directories," notes Michael Wixon, who is Banyan's director of partnerships.

In April, Banyan unveiled Universal StreetTalk, which is a directory service available free of charge to software and hardware suppliers. Cisco Systems, Collabra Software, Oracle, and SAP AG have all indicated they will incorporate it in their products.

While such work represents a step in the right direction, Universal StreetTalk is still proprietary and requires at least one Vines server. Users would prefer a standards-based solution, such as X.500 (see the text box "X.500: The Once and Future Answer" on page 52). But standards-based technology can be painfully slow. X.500 work was begun in the mid-1980s, and there's still no fully compliant product on the market.

Another directory service vying for contention is Network Information Services Plus (NIS+), from SunSoft (Mountain View, CA), which is also bundled with Unix OSes from Hewlett-Packard, IBM, Novell, and The Santa Cruz Operation (SCO). NIS+ is built on Sun's earlier NIS (also known as Yellow Pages), which was eventually licensed by all OEM Unix vendors and became the de facto standard for directory services. NIS was itself designed to attack the shortcomings of Domain Name Service (DNS), notably in the areas of database synchronization and security. NIS+ works with Sun's SolarNet and management tools for Microsoft's LAN Manager and NetWare.

Like DNS, NIS+ uses tree-structured hierarchical directories. DNS provided central control of the directory space but also allowed administrative responsibility to be distributed. NIS+ builds on this by giving every organization control over its domain namespace. NIS+ keeps directories synchronized between name servers by transmitting only changes; its predecessor had to send the entire directory map.

The Users Revolt

Historically, vendors developed separate proprietary solutions to network directory problems and then marketed the differences as advantages. Users had to evaluate competing standards and systems, often trading one feature for another.

After a while, big users realized that vendors might not come up with the solutions they wanted. A number of organizations formed the Network Applications Consortium (NAC), which today has 26 members, including Compaq, Nike, Texaco, and the U.S. Marine Corps. During the past few years, the group has met with key suppliers, issued position papers, and tried to forge consensus early in the development cycle.

In April, NAC met with Banyan, IBM, Lotus, Microsoft, and Novell to discuss directory issues. Larry Gauthier, director of network services at the University of Michigan and current NAC chairman, says, "We don't want to end up with another situation like we had a few years ago, when Lotus was pushing Vendor-Independent Messaging (VIM) and Microsoft was backing MAPI."

The University of Michigan outlined a solution to a critical problem: X.500 is too complicated to run on PCs. The university slimmed down the X.500 client protocol, calling its new protocol Lightweight DAP (LDAP). Lotus's Greg Loux was impressed with the work and said LDAP could become the dominant way for client systems to access X.500 services. However, no vendor now offers LDAP support.

"A lot of users think X.500 will emerge as *the* solution, but I'm not sure they fully understand the problem yet," notes Novell's Eckert. "There just hasn't been enough customer experience to determine how practical it is to implement and what benefits customers receive from it."

A Series of Compromises

Directory services are generally so entrenched that a company rarely eliminates one, even for a better solution. Instead of trying to cut administrative chores, organizations are more interested in causing the least disruption for users. Gallup's Gilkerson is interested in using Banyan's Intelligent Messaging but notes the company has a large investment in cc:Mail.

The local installed base—whatever it is—exerts a tremendous braking force on efforts to change, to simplify, to standardize. Although the benefits of centralizing directory services are quite clear, achieving and implementing the changes is profoundly difficult and moves with glacial speed. Still, we can do a number of things to deal more effectively with the directory systems we have right now (see the text box "Tips for Managing Multiple Directories" above).

And there's a new factor. Internet access and the World Wide Web are growing at incredible rates, and they don't use X.500 or LDAP. The Internet IP addressing scheme and the Web's complex but widely used uniform resource locators (URLs) are primarily addressing conventions, not directory systems. Still, they're based on the Unix world's DNS. And clearly, they'll have a big impact on the future of network addressing.

So where will we go with network directories? How will we find out how to address a message to Joe in our Podunk office? For now, the most practical solution is sometimes to call up Joe on the telephone and ask for his E-mail address. ■

Paul Korzeniowski is a freelance writer in Malden, Massachusetts, who specializes in networking issues. You can reach him on the Internet at 6841944@mcimail.com or on BIX c/o "editors."

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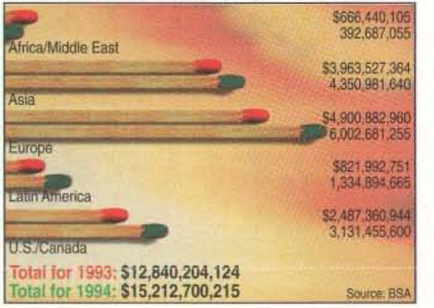

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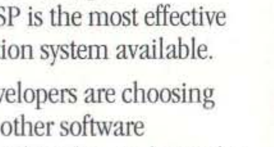

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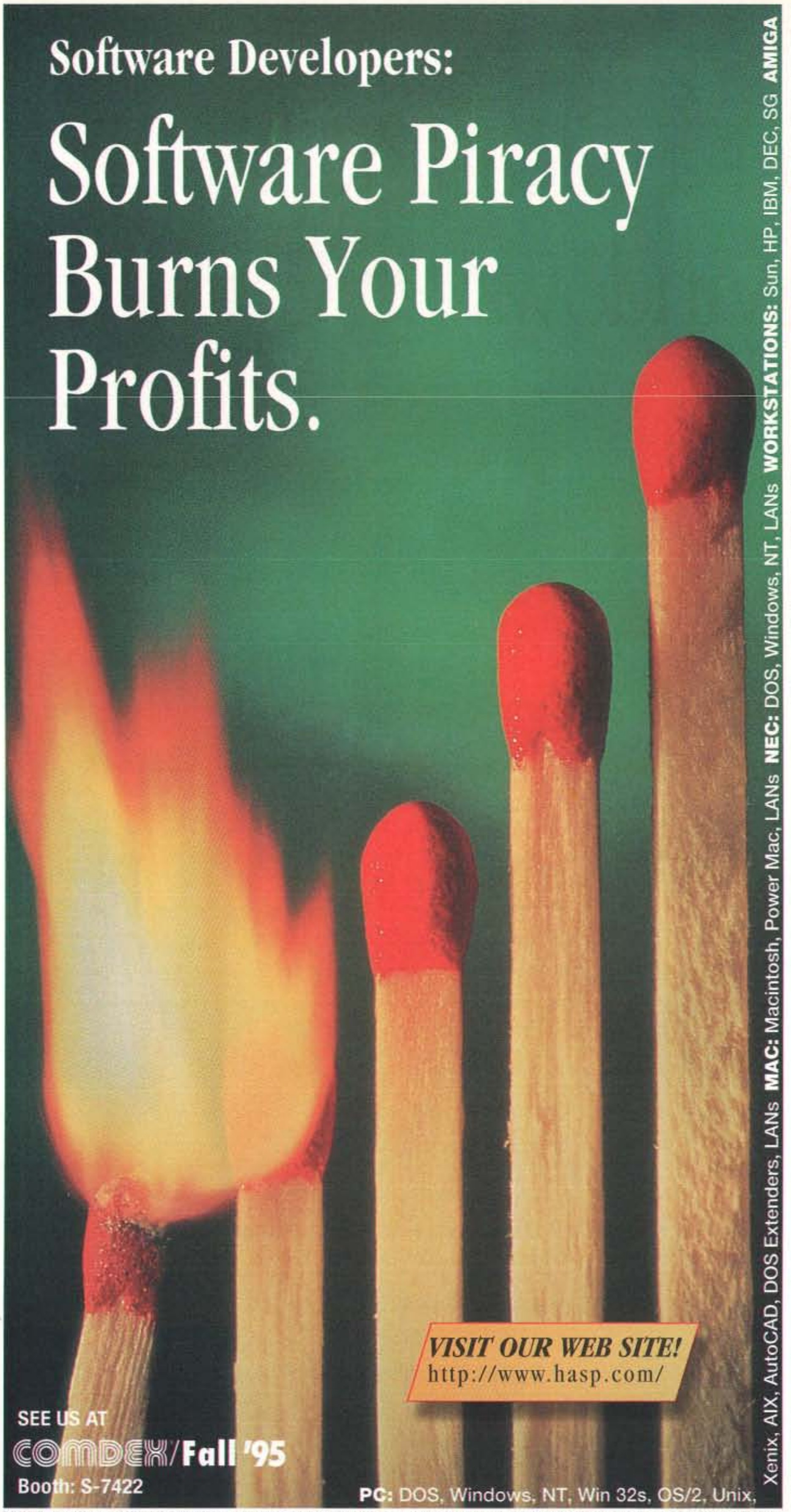

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Hyper-G Organizes the Web

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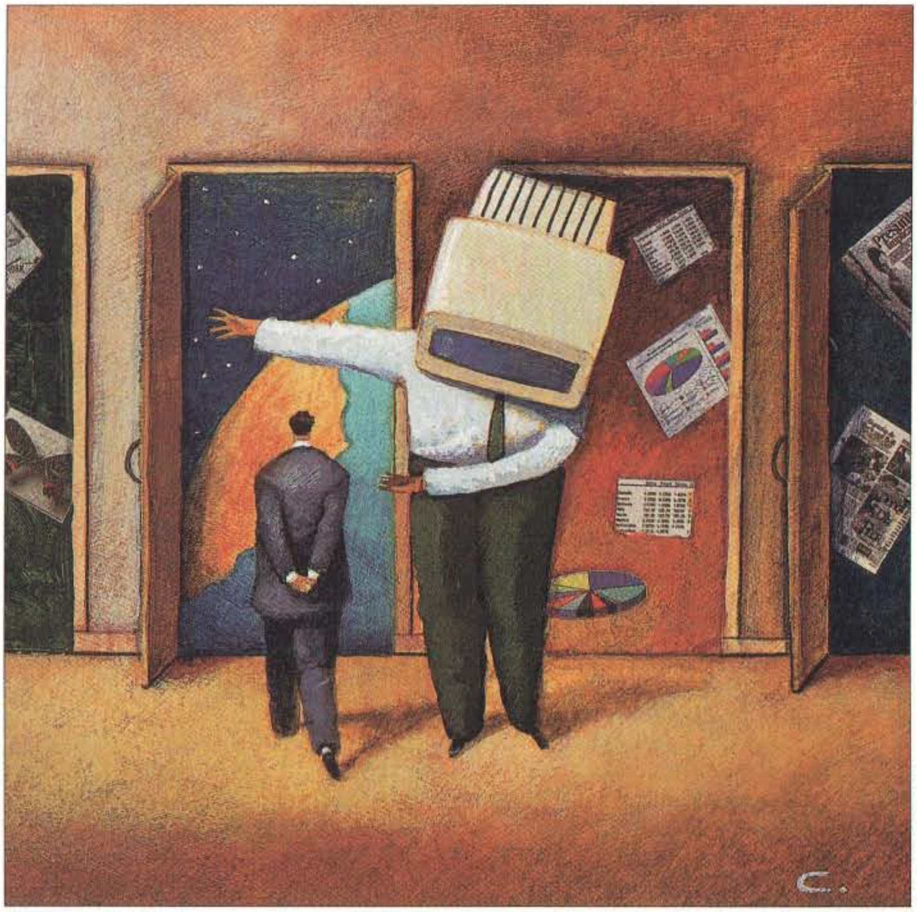


DAVE CUTLER © 1995

Finding what you want on the tangled Web could be much easier with this new, powerful data architecture

Hypertext and hyperlinks sounded like magic when Ted Nelson proposed them in his 1974 book *Computer Lib*. When the World Wide Web brought real hyperlinking to the Internet in 1991, it seemed to be fulfilling that promise of near-universal access to disparate data.

But then the reality hit. An avalanche of servers, documents, and hyperlinks, compounded by the exponential growth in Web usage, has all but buried its usefulness for real work by any but the most determined. And the work needed to maintain a thriving Web site can become a nightmare, too. But that's nothing compared to the problems of organizing massive amounts of unstructured data on the Web. This calls for a new approach.

The answer may be Hyper-G, a second-generation hypermedia information system that tries to combine the advantages of the Web, WAIS (Wide Area Information Service), and Gopher while minimizing their disadvantages. Hyper-G offers a number of direct advantages: a consistent search interface over a number of servers and services; the ability to know where you are in cyberspace; the power to not only access but contribute information; and the assurance of referential integrity (no dangling hyperlinks) and reliable links. Existing Web browsers can be clients of Hyper-G servers (they just won't get all the features), and Hyper-G browsers can be full-featured clients of normal Web servers.

Hyper-G was conceived at the Graz University of Technology, in Austria, by a team headed by Hermann Maurer and Frank Kappe; most development is still being done there. Some organizations with large Web servers are switching to Hyper-G, the best-known being the European Space Agency (ESA).

A New Way to Manage Web Documents

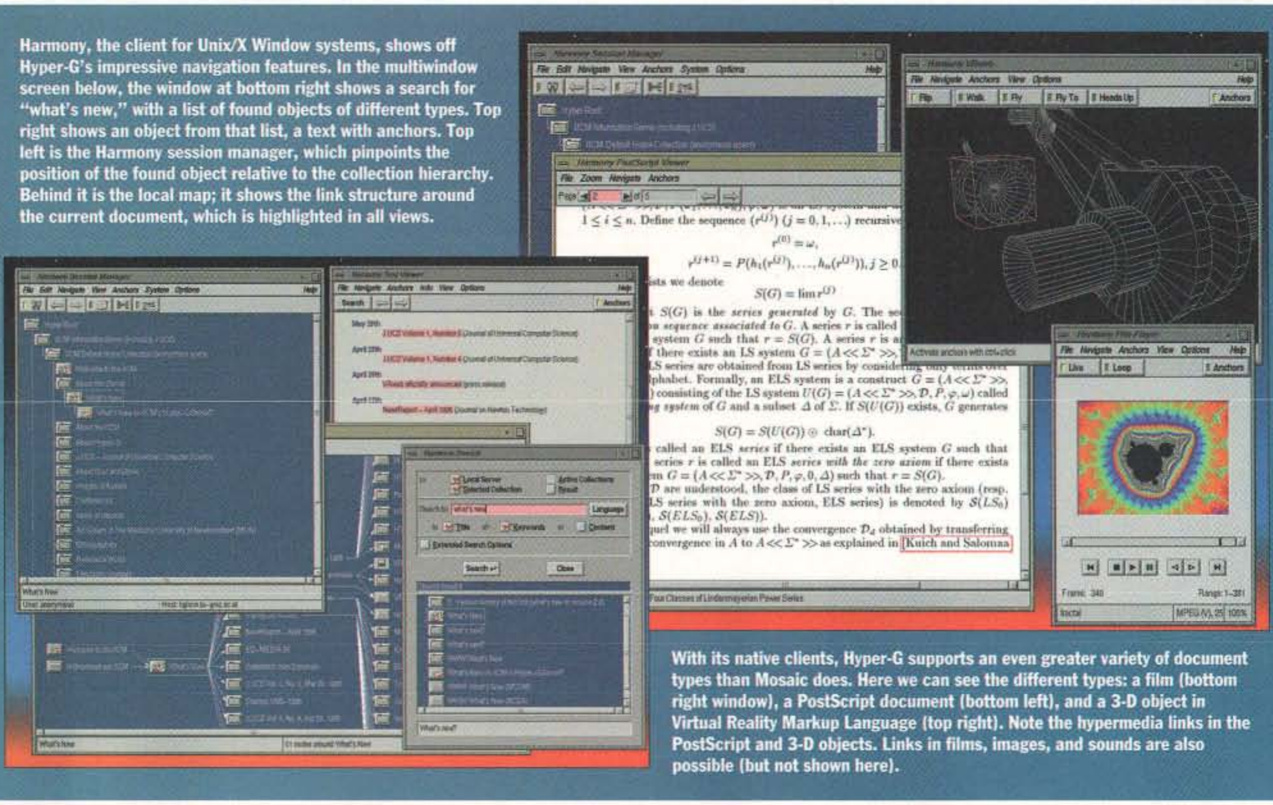
Hyper-G represents an advance over the Web as we've known it because it provides real hypermedia. It supports tools for structuring, maintaining, and serving heterogeneous multimedia data. Hyper-G guarantees automatic hyperlink consistency, and it supports hyperlinks among multimedia documents, full-text retrieval, a Unix-like security system, and client gateways to Gopher and Web browsers such as Netscape, Mosaic, and MacWeb. Similarly, it includes seamless access to popular Internet server technologies, such as WAIS and Gopher.

Hyper-G clients access Hyper-G servers across the Internet, allowing users to view and to manipulate information in multiple ways. Advanced navigation tools help keep surfers from getting lost in hyperspace.

Links to More Data Types

In the Web, links are restricted to anchors in text and, to a lesser extent, in graphics. Hyper-G, however, supports anchors in many data types: graphics, sounds, 3-D objects, PostScript documents, or video clips. Links in Hyper-G are bidirectional. Contrary to normal Web practice, links aren't stored in documents; they're stored

Hyper-G Organizes the Web



Harmony, the client for Unix/X Window systems, shows off Hyper-G's impressive navigation features. In the multiwindow screen below, the window at bottom right shows a search for "what's new," with a list of found objects of different types. Top right shows an object from that list, a text with anchors. Top left is the Harmony session manager, which pinpoints the position of the found object relative to the collection hierarchy. Behind it is the local map; it shows the link structure around the current document, which is highlighted in all views.

With its native clients, Hyper-G supports an even greater variety of document types than Mosaic does. Here we can see the different types: a film (bottom right window), a PostScript document (bottom left), and a 3-D object in Virtual Reality Markup Language (top right). Note the hypermedia links in the PostScript and 3-D objects. Links in films, images, and sounds are also possible (but not shown here).

in separate databases. This means links can be attached to any type of document, such as an MPEG file, and the document format doesn't have to know about the link or how it operates. For Web links, however, you would have to change the document itself to put a link from it to another. One more advantage is that links can be attached to read-only documents—on CD-ROM, for example. Here are some other significant features:

- Support for multilanguage documents allows users to choose the language in which documents are presented.
- Information Landscape offers an interactive, 3-D representation of the database structure. Users can "fly" over the information hierarchy, represented as a virtual landscape. (See the screen on page 62.) The color and height of specific landmarks, for example, represent document type and size. Two-dimensional maps are also standard. Any changes made to documents and databases are immediately reflected in both representations.
- Documents have attributes—for example, author, keywords, and creation date—that can be used in searches.
- An underlying object-oriented database ensures data consistency and integrity.

You can appreciate some of Hyper-G's features only if you use a generic Hyper-G browser. Currently, two are available: Amadeus for Microsoft Windows and Harmony for the X Window system (see the screens above). A client application for the Macintosh will be available soon. Generic clients are not really meant to compete with Web clients; besides the advanced navigation features, the main reason for using a generic client is authoring capability, so you can modify documents.

Similar to a Web browser, a Hyper-G client contains a component that communicates with the server plus a number of internal viewers for various document types. In Harmony, these include text, image formats, video, audio, and PostScript. It can also handle highly complex 3-D scenes and models specified in a description format such as Virtual Reality Markup Language (VRML). External viewers can replace the native viewers.

A central component of Harmony's navigation aids is the session manager. It provides location feedback at all times, regardless of whether you reached an object by following a hyperlink, through a search, or by clicking on the local map.

For video, Hyper-G allows the definition of a link anchor that follows an object of interest in the video. In Harmony, these may be activated both during playback and when the video is paused.

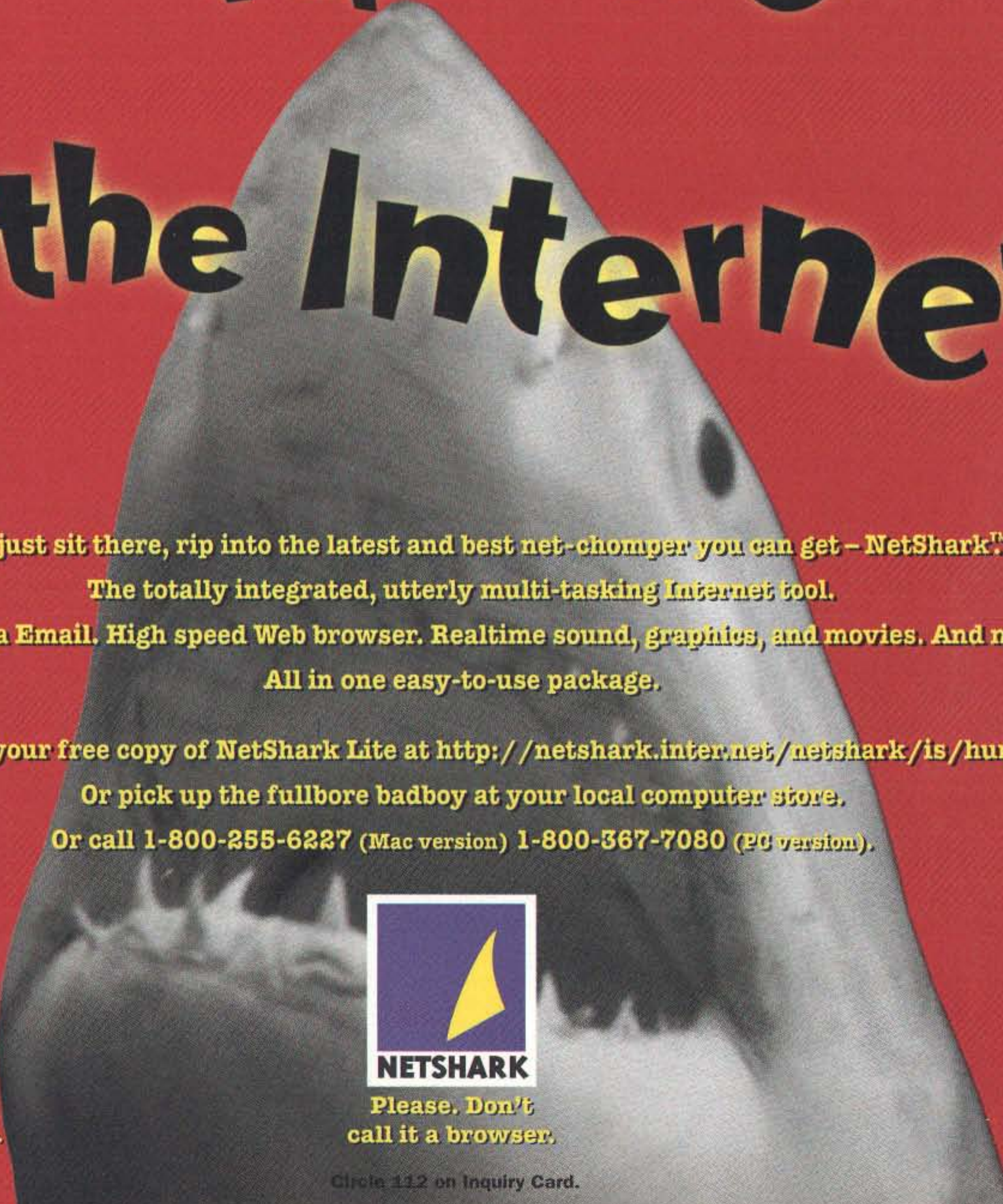
Searches in the native clients, as well

Why the Web Won't Work

There's only one structuring mechanism to handle all the different types of data and documents on the World Wide Web—hypertext anchors that link to other documents. Although this approach can be used to create menu-like hierarchical structures, Web databases are basically flat-file collections of documents with pointers.

The Web's limitations become apparent when you begin to maintain more than a few hundred Web pages. Here are some major weaknesses:

- No full-text search mechanism is built into the Web server, let alone the possibility to search across boundaries of Web servers.
- Because the Web currently lacks authorization features, servers are often implemented as islands, even within the same organization, to prevent access by unauthorized parties. This defeats the Web's underlying principle of tying information together, and it makes global searches even more difficult.
- The way hypertext transport protocol (HTTP) operates on the Web, an object that's located with a given URL may not be accessible at a later time. Moving an object to a different location changes the URL needed to access it. Even worse, a given URL can point to one object at one time and to a different object at another.
- You can't follow links backward. This makes it impossible to determine what other documents, even within a single server or Web site, refer to the one that you're about to move or delete. The inevitable result is dangling links.



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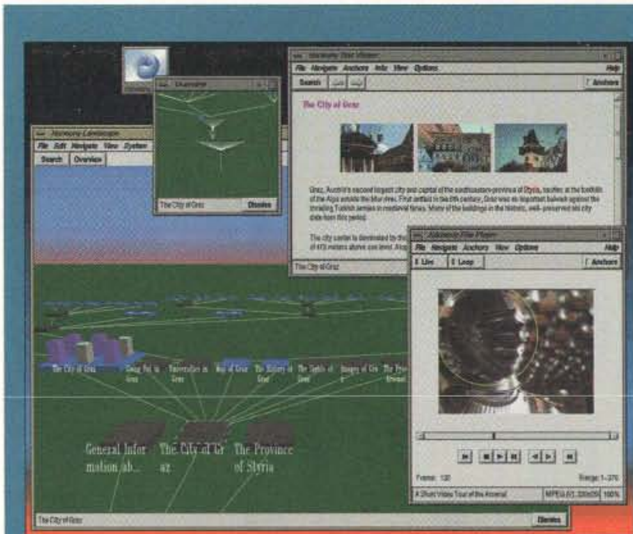


Caution: low-flying searches. Harmony has 3-D navigation features, which the inventors of Hyper-G call Information Visualization. The Information Landscape is at bottom left. The low blocks in the front are collections; behind them are the subcollections, with their documents on top of the corresponding block. Color indicates document type; height indicates size. Above it is a 2-D overview. At top right is the selected text, while bottom right shows video with a clickable hypermedia anchor. The Information Landscape can also be enhanced with textures and patterns.

as from a Web or Gopher client, provide a full range of query refinement. You can do Boolean or fuzzy searches, as well as searches by attribute or content, and you can specify the scope. Results are provided as a list, ranked by the server's estimate of each document's relevance.

Document Structure and Server Interaction

When we talk about Hyper-G's architecture, we really have to consider two separate architectures: the structure of the documents, and the way in which servers interact with one another. These are related, of course, because data can be distributed across multiple servers.

Hyper-G structures data hierarchically. The basic item of a Hyper-G database is a document cluster rather than a single document. (See the figure "The Hyper-G Data Model" below.) This simplifies the implementation of such features as multiple languages or multiple graphic representations (a picture stored in different resolutions, for example).

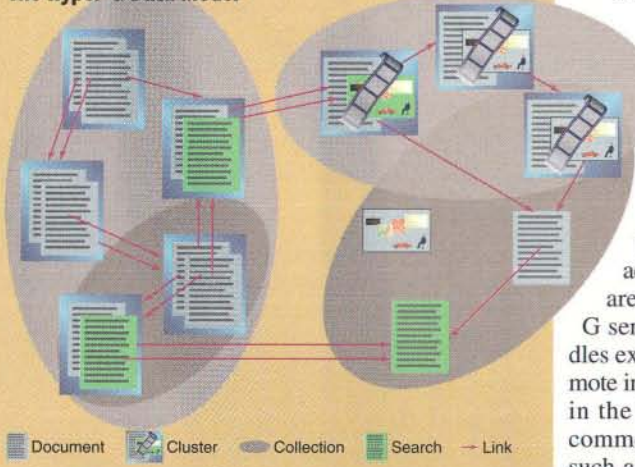
Document clusters in Hyper-G are combined into collections. A collection can be part of one or more parent collections. This provides a big advantage: You can insert a document into a collection without having to first define the links. This is impossible in the Web, where a document with no link is inaccessible; in Hyper-G, it's simply part of the collection structure.

Collections (and document clusters) can have attributes, which are searchable. Collections can span multiple Hyper-G servers, providing a unified view of distributed resources. All servers worldwide are members of a virtual "root collection" called Hyper Root.

A Hyper-G server keeps track of object attributes, arranges collections, and connects clients with the link database. It also encompasses three separate server components: the full-text server indexes text documents, the document Server manages documents, and the link server stores hyperlinks and ensures consistent link references. (See the figure "The Client/Server Architecture of Hyper-G" on page 64.)

Hyper-G uses an efficient, connection-oriented protocol. Unlike Web or Gopher clients, which usually talk to many different servers during a session, a Hyper-G client connects to a single server. If documents from a remote server are needed, the local server fetches them and passes them along to the client. This approach has advantages: Users have to identify themselves to only one server, where accounts and access rights are maintained; the Hyper-G server, not the client, handles external protocols; and remote information can be cached in the local server. Users of commercial on-line services, such as America On-Line, get some of these benefits when they access the Web through their service, but only because the service has chosen to work that way. Hyper-G is completely decentralized and does its job regardless of which service provider the user has.

The Hyper-G Data Model



In Hyper-G, documents can stand alone but are most often considered as document clusters, which can group different representations or versions of the same document. Clusters are themselves organized in collections managed by the server. Searches can locate and access documents in the same collection, in parent collections, and in unconnected collections.

A server/server protocol ensures consistency across server boundaries in a distributed Hyper-G database, and a client/client protocol allows local Hyper-G browsers to communicate with one another via the server.

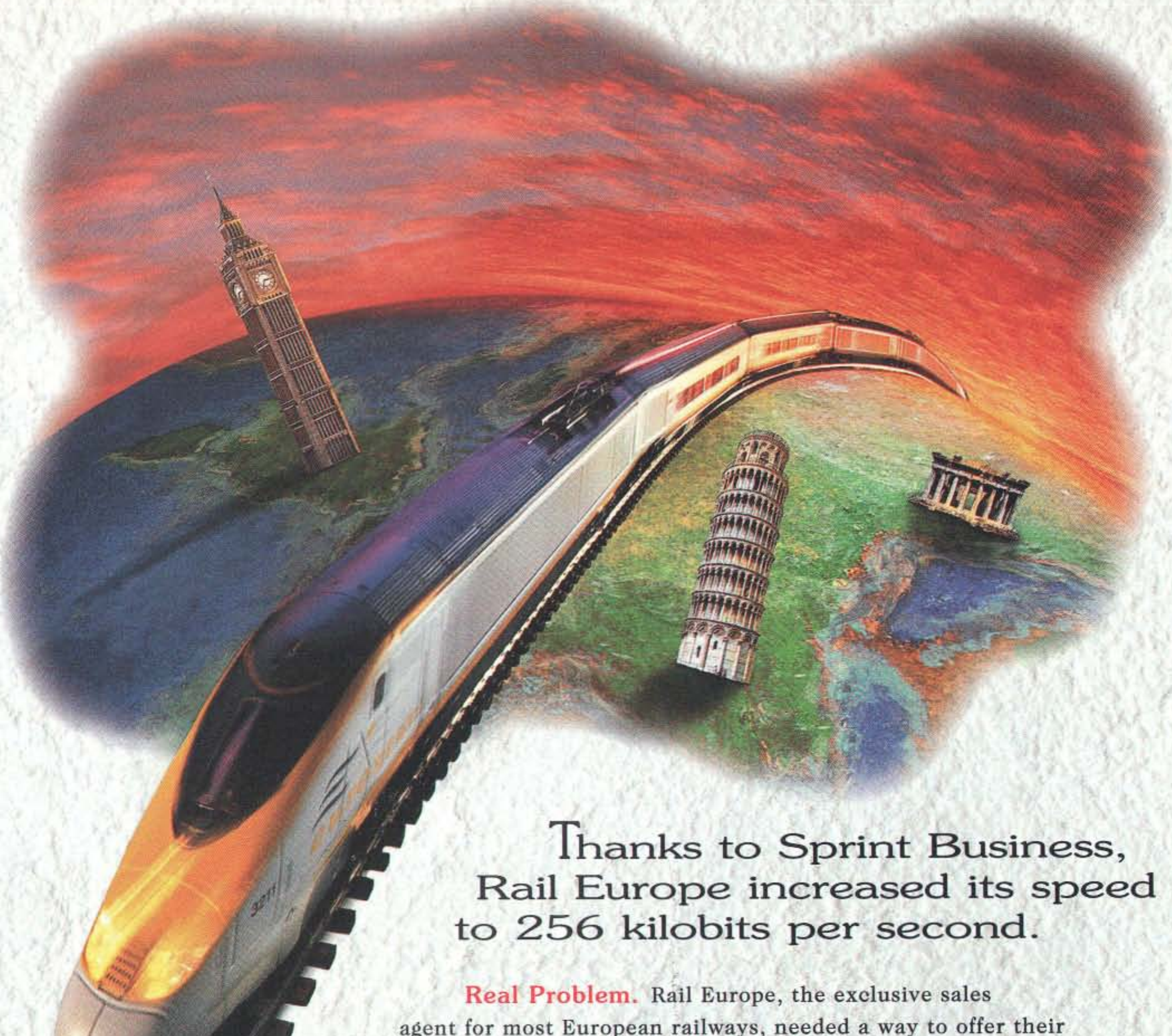
Hyper-G servers can store pointers to remote objects on Gopher and Web servers. Documents from those worlds are transformed into Hyper-G representations—Gopher menus become collections. Similar gateways to WAIS and FTP will be added soon.

When Web clients access Hyper-G servers, specified levels of the collection hierarchy and documents are converted into Hypertext Markup Language (HTML) documents on the fly, complete with links. Most other Hyper-G functions, such as identification, language selection, and searching, are also made available to the Web user. Advanced features, such as 3-D navigation or modifying documents from within the browser, do not map to the Web; they require a Hyper-G client.

Security Measures

Hyper-G has a sophisticated authorization mechanism. It specifies for each user the rights to read, link, modify, and annotate documents, and it supports anonymous users ("guests"). An administrator can assign access rights on a per-document or a per-collection basis. Each user has a home collection for storing pointers to resources and personal documents.

Hyper-G uses a hierarchical access scheme. Authors may grant individuals or groups the right to read, write, link, or delete documents. Some Web browsers allow users to make annotations, but these are implemented in the browser software



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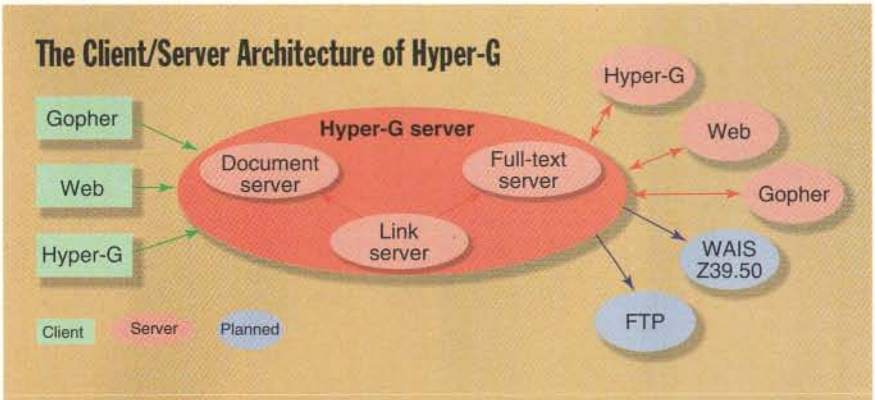

Hyper-G's efficiency stems in part from its division of labor among servers. The Hyper-G server keeps track of object attributes, arranges collections, and connects clients with the link database. The full-text server indexes text documents, the document server manages documents, and the link server stores hyperlinks and ensures consistent link references. Clients and outside services, such as the Web and WAIS, see only the single Hyper-G server.

and stored locally. In Hyper-G, you can set up authorization classes for annotations, permitting private, group, or public annotations to the primary document.

No secure payment mechanism—for transmitting credit card information, for example—is available within Hyper-G yet, but the European Union is about to start a project that will bring high security standards to Hyper-G. This is a prerequisite for commercial applications.

Compatibility and Conversion

One of the really big questions about a project like Hyper-G is this: Can the Web as we know it, whatever its shortcomings, be successfully challenged by a newcomer? Compatibility is crucial, and Hyper-G's developers have gone to great lengths to ensure compatibility between Hyper-G and the Web. In fact, you might never notice that your Web browser is accessing a Hyper-G server rather than a Web site.

To convert an existing Web system with a number of servers into a Hyper-G system, the migration path is straightforward enough. For example, an organization that maintains five different Web servers, each belonging to a different department, could convert them into five Hyper-G collections, which in turn would belong to a single collection for the organization as a whole. Using Hyper-G's authorization structure, modification rights would still remain with the individual departments, but users could now search for a particular piece of information across the database as a whole. No modifications to the original HTML documents would be required. People could still use their Web browsers to access the system, but they might eventually want to switch to Hyper-G client software to take advantage of Hyper-G's additional features.

Hyper-G's developers have used their experience from the Web and other large-scale networked multimedia systems, incorporating into the basic Hyper-G all those features that have been recognized as indispensable but cannot be easily implemented on the Web. Hyper-G provides a uniform and controlled environment; while similar features might be implemented on top of the Web using external applications, this approach would eventually lead to differences between sites.

High Performance, Low Overhead

Not much hard data on Hyper-G's performance is available yet, but experience suggests that database size is almost irrelevant to the speed of searches, since pre-indexing is used. The campus server at Graz manages about 85,000 documents and 130,000 sessions per month, with an average of 300 simultaneous users. This server is a rather ordinary SparcStation 10/40 with 64 MB of RAM. The server runs at about the same speed on a Linux PC with a 100-MHz Pentium processor and 32 MB of RAM.

Until this fall, native Hyper-G documents had to be encoded in Hyper-G Text Format (HTF). Now you can use version 3.0 of HTML, the Web's native formatting language. HTML will probably supercede HTF. Overhead for non-native clients (i.e., Web browsers) doesn't seem significant now and will become negligible as HTML 3.0 comes into use. It will also soon be possible to annotate documents from within a Web client.

The Hyper-G standard components are written in C++ and were partly developed using the Interviews toolkit library. Hyper-G runs on most flavors of Unix, and the development team plans a port to Windows NT. According to Frank Kappe, the Hyper-G code is copyrighted but freely available to all, just as Mosaic is.

It takes only a few hours to set up a Hyper-G server. The standard distribution package includes a semiautomatic installation procedure, as well as tools for inserting, modifying, and deleting objects in the database. These are most often used in scripts (e.g., using the Perl language) for mass insertion of data. One utility, called hifimport, can be used to create stand-alone versions of a Hyper-G Interchange Format (HIF) file; this could, for example, be used for CD-ROM production. Another utility, called haradmin, helps maintain the user database.

The Future

The Gopher gateway (which makes Hyper-G accessible from Gopher clients such as GopherVR) will be enhanced to offer Gopher server administrators a migration path to Hyper-G. Also, there's a tool to import a Gopher server's data to a Hyper-G server. The University of Minnesota has embraced Hyper-G for the next generation of its Gopher information system and is working on a native Hyper-G client for the Macintosh.

Hyper-G isn't perfect. One of the problems seen so far is that clients like Harmony or Amadeus do not handle defective (or syntactically incorrect) HTML documents very well. In these cases, there can be problems getting a document up on the screen, and people would have more luck using a normal Web client.

Hyper-G is a stable, powerful, and, above all, *available* alternative to the World Wide Web that offers something no other Web-based technology does. It can organize the mass of unstructured data and unmanageable hyperlinks. Whether Hyper-G has a chance to make an impact in the decentralized and frankly anarchic environment of the Internet remains to be seen. But it's also possible that it could supersede the Web and we users won't even notice. ■

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You can test-drive the Hyper-G system using a Web browser such as Netscape or MacWeb. A good starting point is the Hyper-G server at the Graz University of Technology: http://hgiicm.tu-graz.ac.at. Consult the doc directory at the Graz site, or FTP to: ftp://ftp.utdallas.edu/pub/Hyper-G. You can subscribe to a Hyper-G mailing list by sending an E-mail message with the line "subscribe hyper-g" to listproc@iicm.tu-graz.ac.at.

Udo Flohr is a science and technology journalist based in Hannover, Germany. He can be reached on the Internet by sending E-mail to flohr@dfn.de.

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Faking It, Then Making It

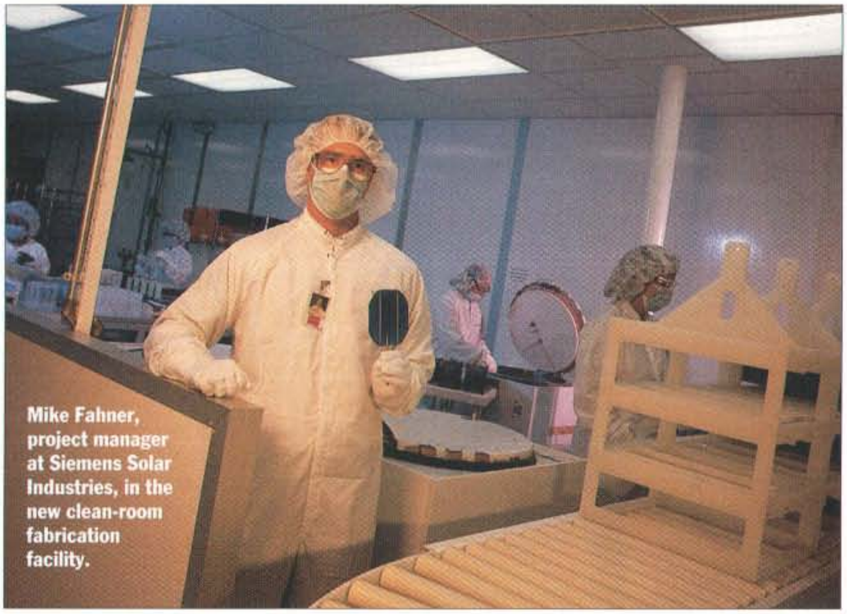
JOHN R. VACCA

If at first you don't succeed, you probably didn't run enough simulations. Take Siemens Solar Industries. It succeeded. How? Before committing its photocell production to a new-to-the-industry clean room, SSI took advantage of simulation software and a nearby university to fine-tune the processes and work-flow procedures it would use. The results were dramatic. The Camarillo, California, company saved over $10,000 in consulting fees. And because it could clear up production bottlenecks in advance, the new clean room is saving the cell-fabrication department roughly $7.5 million annually.

The key was simulation. No longer just computer games for the intellectually curious or exercises in the computer-science curriculum, today's simulation software has come down from the world of FORTRAN subroutines and is appearing on desktop computers.

Now simulation is making its way into the world of business and industry. It was important in an earlier business-process reengineering effort at SSI, and during the past year simulation helped fine-tune the planning and operation of a new production process and fabrication facility.

It's always better to make mistakes on a model than to screw up in production. That's why the solar industry's first clean room started life as a simulation.


Mike Fahner, project manager at Siemens Solar Industries, in the new clean-room fabrication facility.

AMY ETRA © 1995

Making a Clean Start

SSI is the world's largest volume maker of solar electric products. Everything from power supplies for telecommunications systems to utility-scale solar electric plants uses its cells and modules. Your lawn might even be an SSI customer: The company also produces solar panels and solar-powered outdoor lighting. It's part of the worldwide Siemens Solar Group, which has locations in Germany, Japan, Singapore, and the U.S.

SSI decided to introduce clean-room contamination-control technology into its photocell fabrication. That spells money—to upgrade equipment and to create a new facility.

A *clean room* provides a controlled environment that filters incoming air and water to high standards of purity. It also controls temperature, humidity, and air pressure, but the key element is air filtration. Clean-room personnel wear special coveralls, hair covers, shoe covers, face masks, and gloves. Clean rooms are standard practice for fabricators in the semiconductor business—you couldn't make a CPU without them—but the solar industry had never used them before SSI decided to take the plunge.

There was a lot at stake. And there were high hopes. "This new facility would enable Siemens to attain higher levels of quality in the cell-fabrication process," says Mike Fahner, the SSI project manager responsible for improving information accuracy and implementing logistics systems to enhance supply-chain performance. "This was also an opportunity to improve productivity by redesigning the facility layout and material flows to increase throughput, decrease the work-in-process levels, and reduce cycle times," he adds.

Efficiency Is the Name of the Game

World-class manufacturing organizations strive to minimize the level of what is called *work-in-process*—that is, the inventory of unfinished goods on the shop floor that are waiting for the next processing step. Work in process represents a capital asset that's tied up—money that could be better invested in things such as plant upgrades.

High inventory levels can be costly. If things move slowly enough, there can even be a cost of obsolescence. If the products are technology-driven where changes occur rapidly, then the administrative costs of managing engineering changes for partially finished goods can be cumbersome.

"At SSI, we considered that computer simulation was an ideal tool to help improve the productivity and quality of the cell-fabrication process," explains Fahner. "Computer simulation provides a virtual laboratory where an engineer can experiment with effects such as adding machines or changing their configuration without the time and expense of making the physical changes."

Computer simulation also allowed SSI to compare numerous alternatives quickly. "We believed that simulation models could predict the effects of proposed equipment investments or modifications with minimal risk," Fahner adds. "We also believed that the primary benefit of the simulation-modeling process was the knowledge and insight we would gain in understanding the interactions within the systems we were designing and studying."

According to Fahner, SSI's primary goals were to model the proposed production process, concentrating on the wafer-diffusion, oxidation, and plasma-etch processes for the new cell-fabrication room. The company also wanted to identify and remove system constraints and evaluate alternative scheduling, delivery rules, and material flow with respect to queue levels, throughput, cycle time, machine utilization, and work-in-progress levels.

Partnering with Poly

Dr. Sema Alptekin, professor of industrial and manufacturing engineering at California Polytechnic State University in San Luis Obispo, California (generally known as Cal Poly), wanted to get her students involved in a real industrial problem using simulation techniques. She approached Fahner after a mutual contact suggested she consider SSI.

Fahner was interested in a partnership with Cal Poly because he's always looking for efficient ways to solve problems with limited resources. Siemens keeps a core group of highly skilled and focused individuals who manage projects using external resources on an ad hoc basis. This approach has allowed Siemens greater flexibility by accessing a specialized knowledge base only when needed, and without carrying costly overhead. (See the text box "Learn by Doing" on page 72.)

The project began on September 23, 1994. Alptekin visited SSI to tour the plant and discuss the project's objectives. Fahner visited Cal Poly twice during the 10-week project, defining project objectives for the students, providing data, and answering questions whenever industrial expertise was needed.

Alptekin's students were excited and willing to visit SSI to learn more about the problem. They also felt greater-than-normal pressure, since the projects weren't hypothetical exercises created by an instructor and ultimately destined for the trash can; their work would be evaluated by industry, and their recommendations might actually be implemented within a few months.

Picking the Right Simulation Tool

Alptekin notes that simulation software has been around for a long time. "It was part of my Ph.D. dissertation in 1981 to write code in FORTRAN as a simple simulation tool to solve a simple problem. With advances in computer technology and software, solving the same problem, which took several years in the 1970s, could be accomplished in several days today," she observes.

After numerous meetings and discussions, the Cal Poly students, with Alptekin's help, selected ProModel from ProModel Corp. (Orem, UT) as the software they would use for the SSI computer simulations. "ProModel is just one of the simulation tools we use," says Alptekin. "We picked ProModel because it was the only available simulation product that was developed as a Windows application," she adds. "It offers the advantages of a true Windows-based product." (See the text box "What ProModel Can Do" on page 68.)

SIMULATING SIEMENS'S CLEAN ROOM

The Problems

- Poor material flow.
- Unbalanced resource utilization.
- Bottlenecks in throughput.
- Schedule delays.

The Solution

- Model alternative scenarios and select the best attributes from each.
- Study the interactions between machines to eliminate bottlenecks.
- Improve material flow and reduce work-in-process levels by implementing a "pull system" based on consumption replenishment.

The Benefits

- Validated process capabilities prior to implementation and met budget and capacities.
- Modified scheduling rules and operating procedures to improve process performance.
- Gained a better understanding of the process, reducing the risks involved in decision-making.
- Developed an analytical tool that can be used for continuous process improvement.

The package's relatively gentle learning curve was critical, according to Alptekin. "Since this was a class project, the simulation tool had to be easy enough to learn and apply in a short time," she explains. "Anybody who's using Windows could learn to use ProModel in a short time." The user does not have to learn a simulation language. It's a point-and-click development tool through its library of tools, icons, and constructs. The package's on-line help and on-line training were also important factors.

In addition, ProModel was well suited for this project-workgroup situation because different members of the group could develop submodels and integrate them into a final model. "It allows the user to start with a small model and develop it to a larger model through the use of submodel and model-merge capabilities," Alptekin continues. "ProModel is also well suited for fast what-if analysis because of its flexibility to accommodate changes and its fast running speed."

The Windows underpinning of ProModel offered other advantages. The students found ProModel's output charts and graphs superior to those of other simulation products, and they could easily paste them into other Windows applications for reporting purposes. Finally, ProModel's animation capabilities were a definite plus. "Animation helped SSI managers validate the baseline model and provided them with a better understanding of their proposed system," says Alptekin.

How the Students Used ProModel

The students used ProModel to develop a baseline that defined the model's scope and objectives based on real data. They also used it to make assumptions to simplify the model, as well as to create

WHAT PROMODEL CAN DO

ProModel is a Windows-based simulation package that you can use to model just about any system of discrete events, such as manufacturing systems, business processes, and service systems.

ProModel schedules simulation events based on predefined parameters. You tell ProModel how and when the entities (in this case, silicon wafers) arrive at each machine, how long each machine takes to service them, and under what conditions. When you run the simulation, the computer processes each event and keeps track of the system's vital statistics as the model changes state.

ProModel provides several standardized reports, graphs, and animations that summarize the results of the system over time. These are valuable in comparing alternative scenarios. Important statistics include system throughput, machine utilization, and average queuing times in the machine buffers.

a model of the network of resources in the system by defining the machines, their capacities, and the probability-distribution functions of their stochastic service times and interarrival rates of incoming parts. Some of the resources in this model included chemical-etching baths, spin-rinse dryers, wafer-transfer stations, diffusion tubes, oxidation tubes, and plasma-etch ovens.

Also, the students used ProModel to define the routines used for producing wafers. There were two product lines in the Siemens model, plus a sequence of operations, batch sizes, and logical rules that determined which machines could be used under specific conditions.

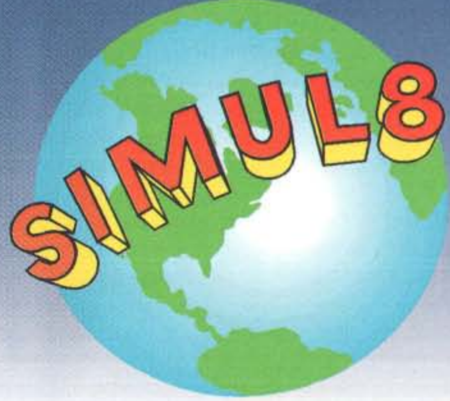
Furthermore, they used ProModel to validate the baseline model, which handled iterative simulation runs, comparison of simulation runs to real performance, and baseline-model validation when the simulation-generated statistics matched the actual performance to the given assumptions. Finally, they used ProModel to develop alternative scenarios to design enhanced systems that met the modeling objectives.

Simulating the Processes

The actual project modeled the wafer-diffusion, oxidation, and plasma-etch processes. The simulation involved the machines, equipment, workstations, storage-and-handling devices, operators, and material and information flows necessary to support the process. SSI and the students developed a baseline model of the proposed system and validated the baseline results from the simulation with actual process data.

Also, SSI and the students developed and evaluated alternative scenarios. Many involved the problems of producing two different models of solar cells that called for different machine setups and process times. The students considered adding extra spin-rinse dryers, diffusion and oxidation tubes, and/or plasma-etch ovens to the system; modifying machine-setup times; and using a different type of dryer that required no setup or changeover. Other potential changes included a variety of scheduling options for both production and parts arrival, modifying batch sizes according to cell model, and changing the distribution of diffusion and oxidation tubes within the facility.

continued



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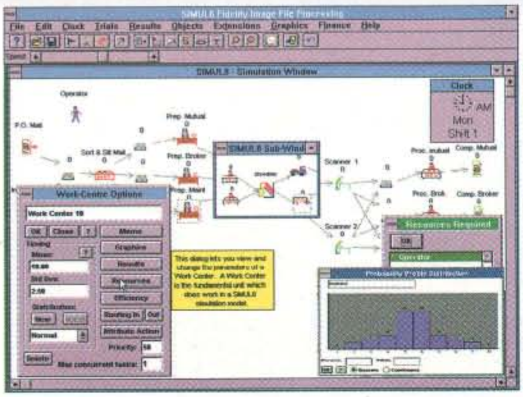
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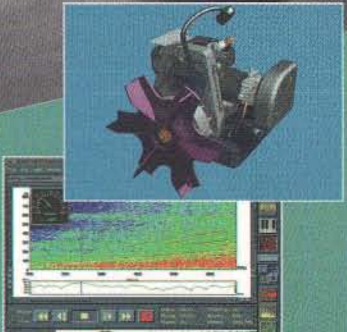

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Recommendations

The Cal Poly students delivered their final report and presentation on December 2, 1994. They proposed specific recommendations on given criteria and objectives, as well as on new operations and organizations. As a result of this project, SSI was able to make significant changes that improved the efficiency of the clean-room facility and plan for further changes that would allow even more productivity.

For example, SSI's solar-cell line includes two types of photocells, called the M-line (which accounts for 62 percent of production) and the PC-line (38 percent), that require different machine setups and production times. The facility's four spin dryers were initially set up so that three handled M-line cells and one handled PC-line cells. Simulation showed that changing the setup to two machines for each model would improve throughput and cut queuing times.

Another change that grew out of the spin-dryer study involved scheduling dedicated shifts for each model type. By running M-line product for 13 consecutive 8-hour shifts and then changing over to PC-line product for eight consecutive shifts, SSI could realize a significant increase in throughput, a reduction in waiting times, and a minimization of time devoted to equipment setup and changeover.

But SSI and the students acknowledged that a radical change in scheduling like this could significantly impact—either positively or negatively—other SSI operations that weren't studied in the simulation project. Thus, SSI needed to do further investigation before implementation.

Simulation showed that, once the spin-dryer constraints were removed, the next bottleneck in the system was diffusion. The students recommended an increase in diffusion capacity by converting a bank of four oxidation tubes to diffusion or, budget permitting, adding another bank of four tubes. They determined that converting tubes would lead to an increase in the overall system throughput and utilization as compared to the baseline model. This finding, coupled with the importance of flexibility in balancing the diffusion/oxidation mix, pointed up the need to find simple and expeditious techniques for tube conversion.

In Production

In February, SSI's Cell Fab I clean room commenced operations. The processes of diffusion, oxidation, and plasma etching for silicon wafers are all done within the 2500-square-foot clean room. Approximately 50,000 wafers per day can be processed through the new $1 million clean-room facility.

The improved capabilities of the new facility, fine-tuned by simulation, have enabled SSI to realize significant production improvements. Also, the simulation project validated the capabilities of the proposed system, and this helped SSI meet its cost and capacity expectations. Finally, the simulations gave SSI a much better insight into the interactions among various elements within the production process, which has led directly to better-defined scheduling rules and operating procedures.

Product yield, which is defined as the ratio of quantity output to quantity input in the cell-fabrication process, has improved from a baseline of 83 percent to its current level of nearly 98 percent. The reduction in scrap loss is primarily the result of better material flow and contamination control in the process.

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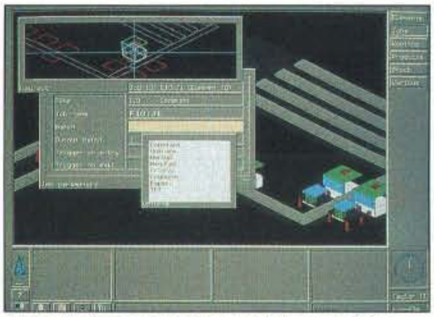

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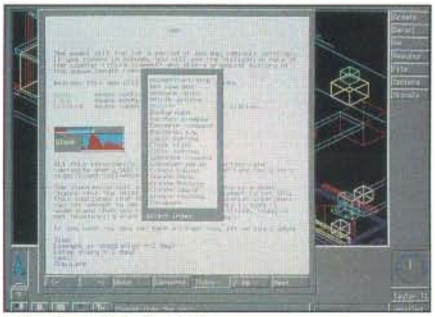

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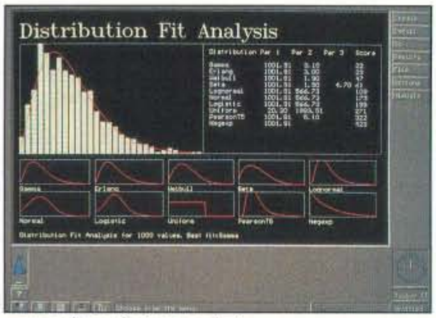

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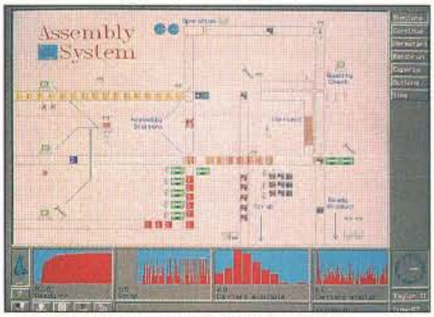

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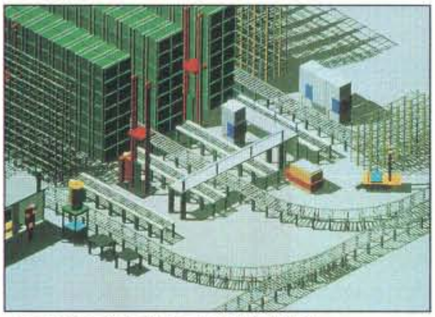

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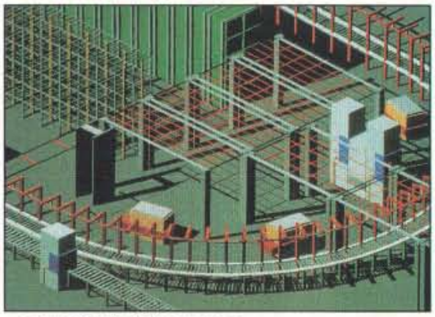

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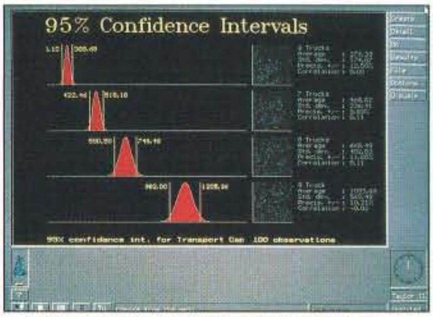

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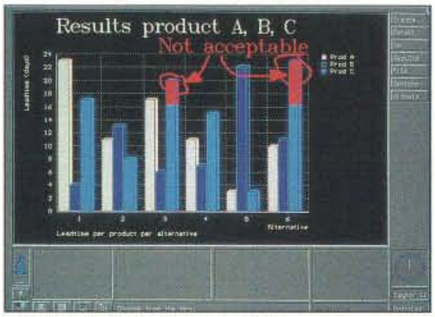

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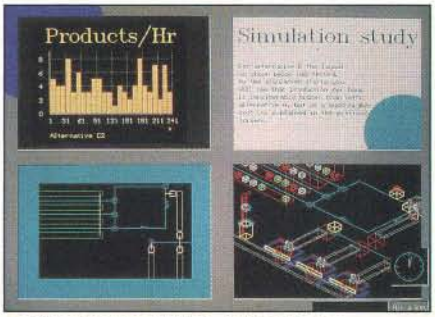

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In addition, process variability, as determined by the wafers' surface resistivity (called *sheet rho*), has been reduced. As the variation in surface resistivity decreases, the fabrication process becomes more repeatable and yields more consistent consistent electrical properties.

As a result of the clean-room implementation, the bottleneck in the process has moved from the diffusion and oxidation processes (which are done in the clean room) to downstream operations. Most of the improvement was due to the installation of additional equipment to increase capacity. However, SSI designed the facility to get more throughput with the same number of operators, and thus the cost per unit has been reduced. Also, improved material flow has resulted in lower inventory levels and reduced cycle times. This allows SSI to be more flexible in responding to customer demands.

Lessons Learned

While SSI's new fabrication process operates effectively, thanks in part to the simulations that went into the planning, there's still room for improvement. In particular, Fahner says that if SSI were to do the simulation project all over again, he would make some important changes.

First, he would involve manufacturing personnel to a greater degree during the what-if discussions when deciding what options and alternatives to explore. Second, he would work harder to develop a stronger in-house simulation capability. This would allow SSI to take better advantage of the model and to use it as a tool for continuing improvement. Finally, he would develop run-time models so that users not familiar with programming could still run the simulations and explore new alternatives with new data.

At the moment, primarily due to cost and time constraints, SSI has no further major simulation projects on the docket, although SSI engineers use in-house simulation tools to create simple models as the need arises. While simulation languages and software applications are improving at an accelerated rate, Fahner acknowledges that simulating a complex process still requires highly skilled engineers, a clear focus, and dedicated time for modeling.

Joint projects, like this one with Cal Poly, can be an effective way of leveraging resources, but this type of cooperative effort requires a significant amount of project management effort. It's an effort Fahner thinks was worth making.

"Overall, it went fairly well," he says. "The Cal Poly students did an excellent job in performing simulation modeling of Siemens's new cell-fabrication clean room. Their analysis was thorough and insightful. In addition to learning about Siemens's processes, they were concurrently learning how to use ProModel simulation software. It was evident that they quickly grasped the fundamentals of analyzing system constraints and applied these methods to Siemens's case study."

In sum, he says, "Their conclusions and recommendations were sound and reasonable, having direct applications to improving Siemens's processes. The presentations were very professional, and the interactive discussions were even more helpful. The real value of this project came from their fresh perspective and insight. The knowledge that they have gained can greatly improve our understanding of the cell-fabrication clean-room process." ■

John R. Vacca is a freelance information-technology and air-and-space contract writer based in Houston, Texas. He can be reached on the Internet at 74044.164@compuserve.com or on BIX c/o "editors."

LEARN BY DOING

When Dr. Sema Alptekin began planning how to teach a graduate course, "Advanced Topics in Simulation," for California Polytechnic State University's industrial and manufacturing engineering program, she wanted to design the course to fit the school's "learn by doing" principle. Cal Poly claims its students take more laboratory courses than students at any other engineering school in the nation. In other words, they not only learn theory, they practice it on numerous engineering management applications. She wanted to give her students a real problem and real data.

Dr. Sema Alptekin

Because she was new both at Cal Poly and in California, Alptekin contacted an old colleague, Dr. Ali Kiran, president of Kiran & Associates (San Diego, CA), who consults with California industry on simulation and scheduling issues. Kiran pointed her to Mike Fahner at Siemens Solar Industries.

Fahner, as it turned out, was enthusiastic about collaborating with Cal Poly on this project, because its students and faculty could buy him resources and expertise that he couldn't otherwise muster. He was also eager to work with Cal Poly because of the reputation of its accredited engineering and business programs. SSI was committed to sustaining a relationship with a local university with talented faculty and students.

No money or compensation was exchanged. SSI would provide technical information and project management, while Cal Poly graduate students would contribute the systems-analysis expertise and put in the time needed to set up and perform the actual computer simulations. The relationship was a cooperative exchange of information and experiences from which both parties benefited.

The two parties decided to hold weekly teleconference meetings, and the students would have to produce periodic progress reports. The 16 students were divided into four project groups, each focusing on one specific part of the system.

The students accomplished a lot in a 10-week quarter. In fact, SSI's experience contradicts the common wisdom, widely believed in industry, that students take longer than professionals to complete projects. Everyone was happy at the end of the clean-room project. The students gained confidence in using simulation as a tool to solve real problems. Fahner and SSI obtained a number of helpful simulation results that would otherwise have taken longer to achieve. And Alptekin had succeeded in making her course more interesting and more meaningful by including industrial projects in an academic setting.

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BYTE SPECIAL REPORT

OPERATING SYSTEMS

Hot new developments in the software that runs the software

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BONUS/Reconcilable Differences

How well has Microsoft met its own goals for backward compatibility in Windows 95? You'll find this article on the BYTE Web site—http://www.byte.com

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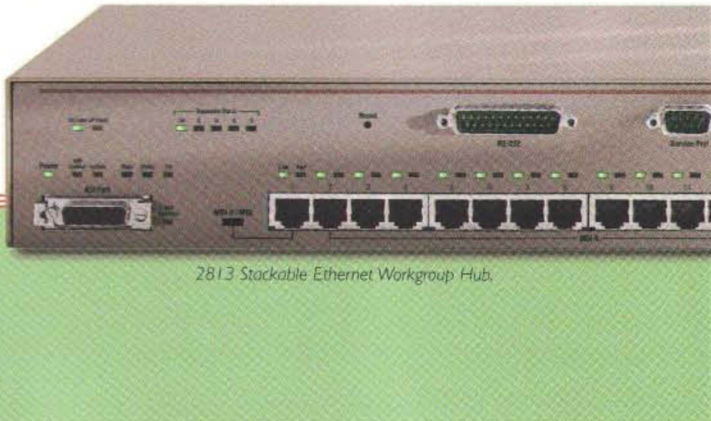

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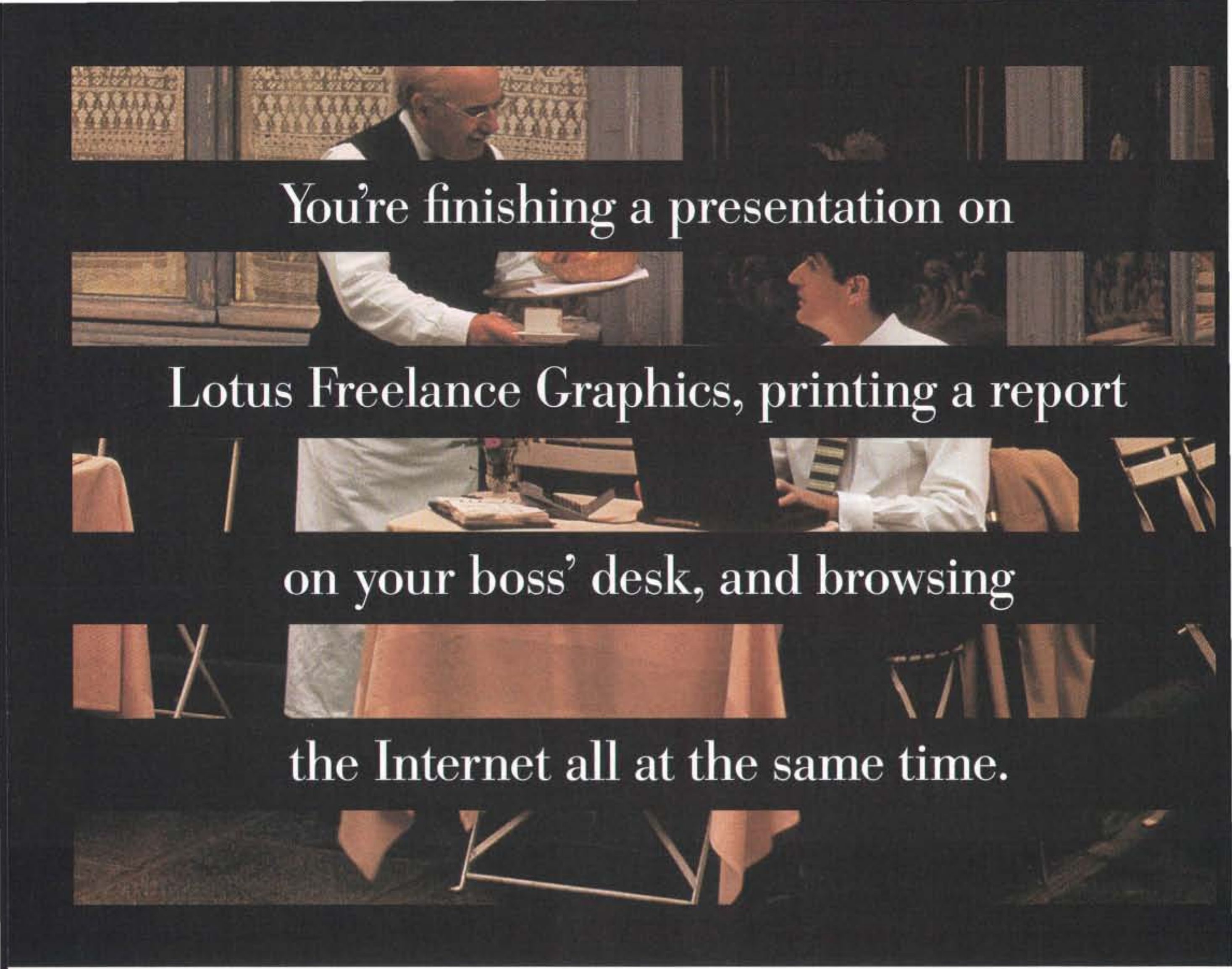
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Smooth Operators

New developments with today's—and tomorrow's—OSes

BOB ROBINSON © 1995

No one ever bought a computer to run the operating system. And yet, OSes often inspire a "rather-fight-than-switch" loyalty among their users. Many users have been caught up in religious wars.

Expectations of OSes are constantly changing. We used to be pretty happy if it simply ran our application and let us manually configure the system with arcane and undebuggable commands. Now, we're miffed unless these software servants can automatically recognize and use all equipment (even on-the-fly modifications); wring the utmost performance out of the CPU, memory, hard drive, monitor, and all the peripherals; network effortlessly with practically any other machine; provide a stable, crash-proof platform for applications to run on; support a simple but rich applications development environment; and clothe the whole shebang in a snazzy designer interface—which users can customize to their heart's content. Not much to ask.

Our lead article ("OS Paradise" by Tom Yager) shows how OS vendors are meeting the challenge with 32-bit desktop OSes possessing some heaven-sent features. Text boxes look at Linux, a public domain superstar ("The Linux Phenomenon"); some behind-the-screens considerations of user-interface (UI) design ("What You See: What You Want?"); and two OS architects who have each gotten a second shot at designing a new OS ("Doing It Over").

Utility programs provide a welcome and necessary adjunct to the powers of the OS. Historically, pioneering features have appeared in utilities first and in OSes later. While Windows 95 has numerous features that were previously offered by third-party utilities, it also opens the door to new possibilities. In "Filling in Windows Blanks," Peter D. Varhol details some fresh opportunities for utilities in Windows 95, as well as some classic utilities for other OSes.

In "Not *That* DOS," Paul Korzeniowski discusses new distributed OSes, many of which exist only in university research labs—but perhaps not for long. Systems such as Plan 9 (from AT&T) and Spring (from SunSoft) have features valuable in the networked world, while Exokernel, Spin, Scout, and Flux explore the outer reaches of OSdom.

Barry Nance ("Sincere OS Flattery") shows how one OS can be made to run applications intended for another, thanks to third-party emulation software. In today's multiplatform office, that flexibility becomes essential.

Object-oriented OSes promise to simplify applications development. But where are they? Dick Pountain explores their nature—and why they don't seem to be moving off the horizon—in "OO Meets OS." The good news is that they really are getting closer.

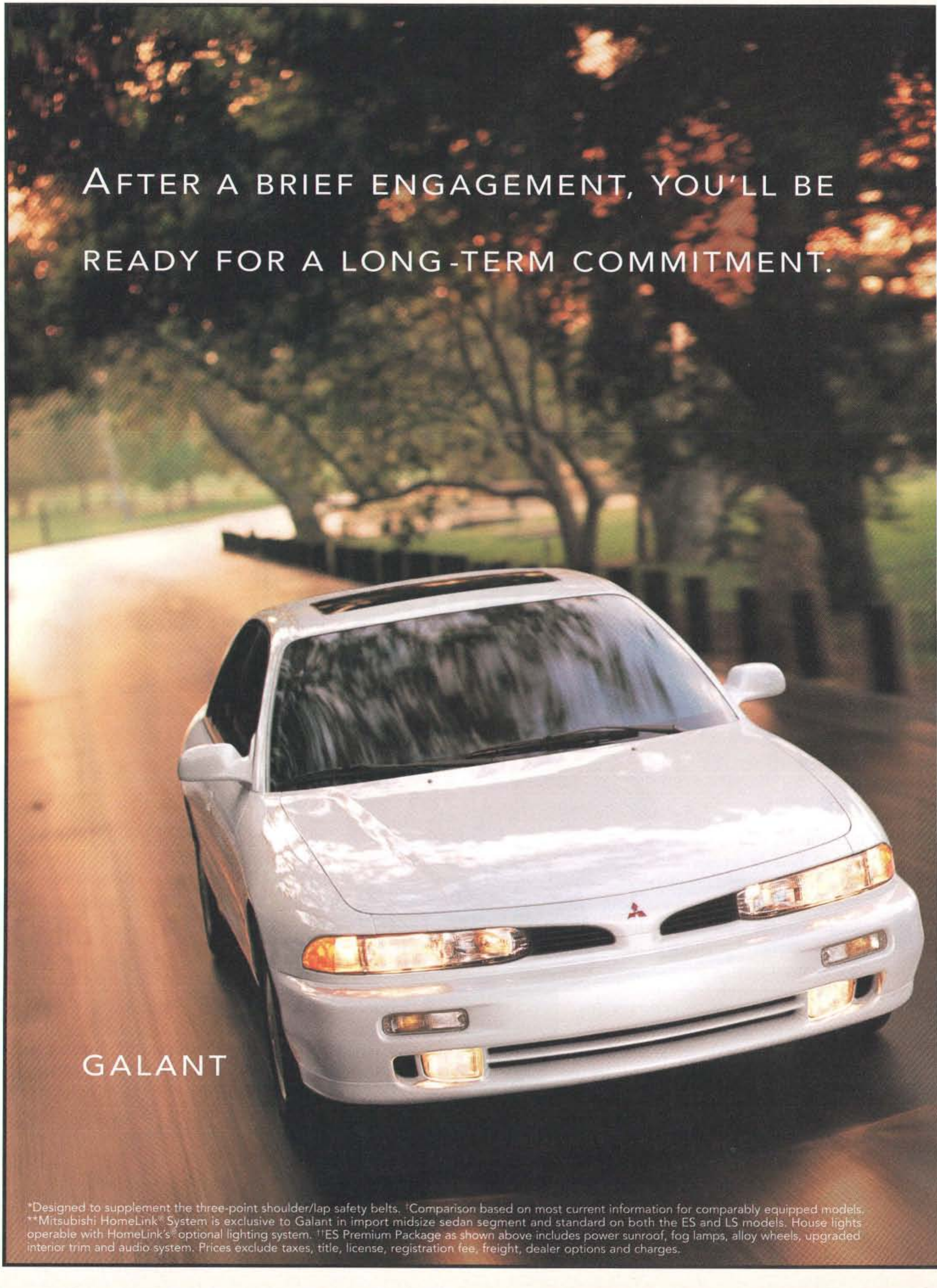
Developers writing applications today must often pay attention to more than one OS platform. David Linthicum leads a tour of development tools ("And One for All") that may simplify cross-platform development chores.

No discussion of OSes would be complete without mentioning crashes. BugNet's Bruce Brown ("Crashing the Party") examines these daily cataclysms from his unique perspective, giving helpful recipes for crashing all the major desktop OSes—and insights into what they reveal about the inner workings of each one.

Available only on BYTE's World Wide Web site (http://www.byte.com), Edmund X. DeJesus's "Reconcilable Differences" examines Microsoft's struggle to maximize Windows 95's compatibility with existing DOS and Windows applications. The programs that still won't work exactly right seem to fall into distinct categories.

Unless you're still running programs by rewiring circuit boards, you're dealing with an OS every day. Our lineup will keep you up on what's new and decidedly different in the software we love to hate. ■

—Edmund X. DeJesus, Senior Editor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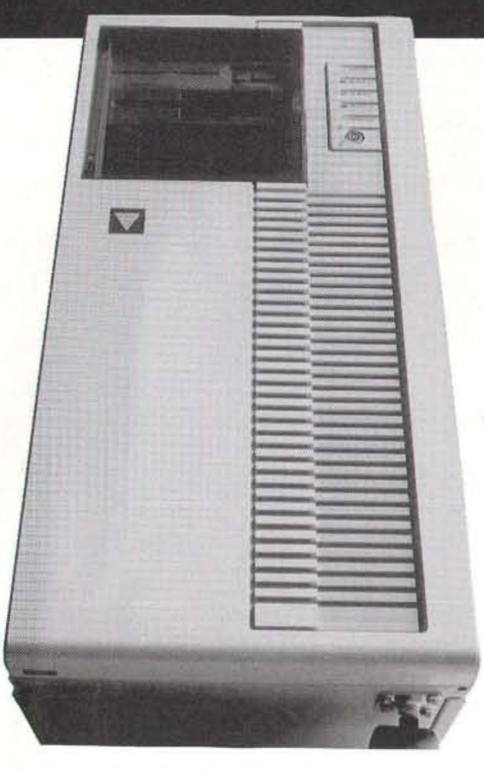

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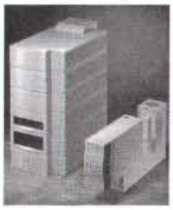

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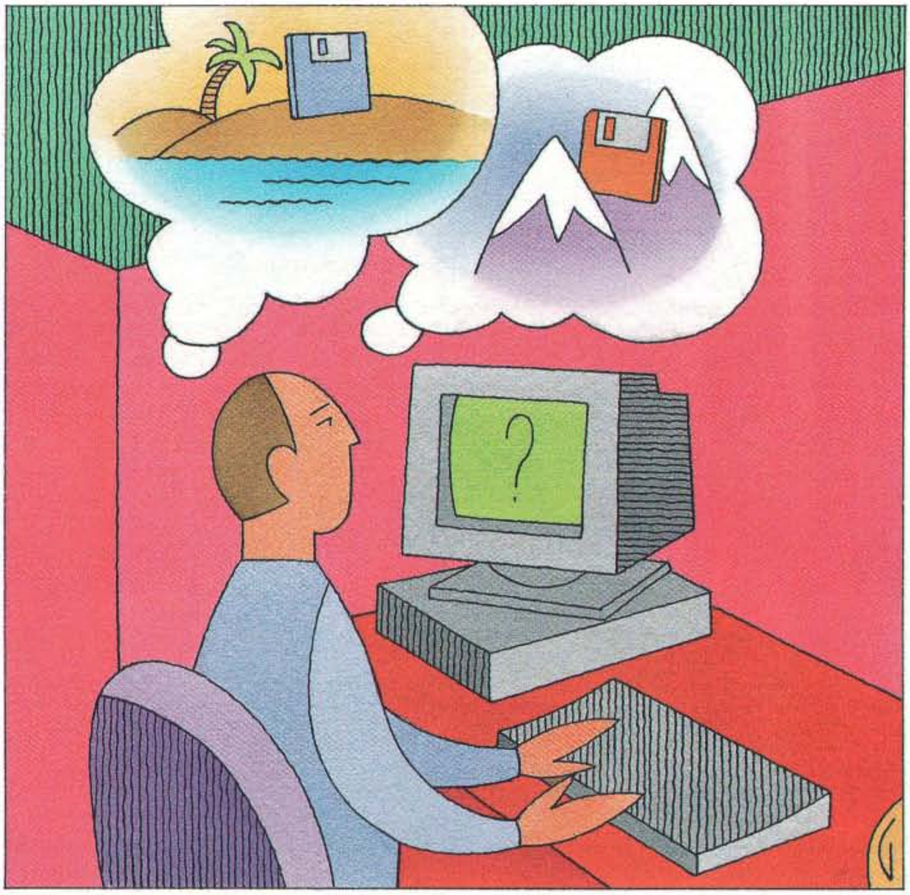

JOSEF GAST © 1995

The lowdown on the latest 32-bit PC operating systems

Shall I take the Ferrari or the Jaguar to the restaurant? Shall I have the lobster or the linguine calimari? Shall I go to the beach house or the mountain chalet this weekend?

No doubt about it, some types of problems are more fun than others. And the problem of choosing a desktop operating system has gotten a lot more fun lately.

Today, there's so much overlap in OS capabilities—at least each vendor's *stated* capabilities—that we're cursed with an embarrassment of riches. For any problem we must solve, several OSes promise a uniquely capable solution. And with the bundling that has become commonplace, OSes sometimes *are* a self-contained solution, applications and all.

So let's look at some operating systems to see what they're good at and not so good at. For this evaluation, we chose a common base—a PC with an Intel or compatible CPU—and five commercial PC OSes: Microsoft's Windows 95 and Windows NT Server, IBM's OS/2 Warp, Novell's UnixWare, and SunSoft's Solaris.

Using Windows 95

A user interface isn't simply a matter of drawing colored dots on a screen. Broader behavioral issues, commonly referred to as "look and feel," shape a user's feelings about his or her computer. We've seen that it can help make the difference between a productive worker and a disgruntled one.

On the benevolent-dictatorship theory alone, Windows 95 has a leg up. Microsoft is not only the sole supplier of the OS, it also sells the platform's most popular development tool (Visual C++) and the most popular suite of applications (Office).

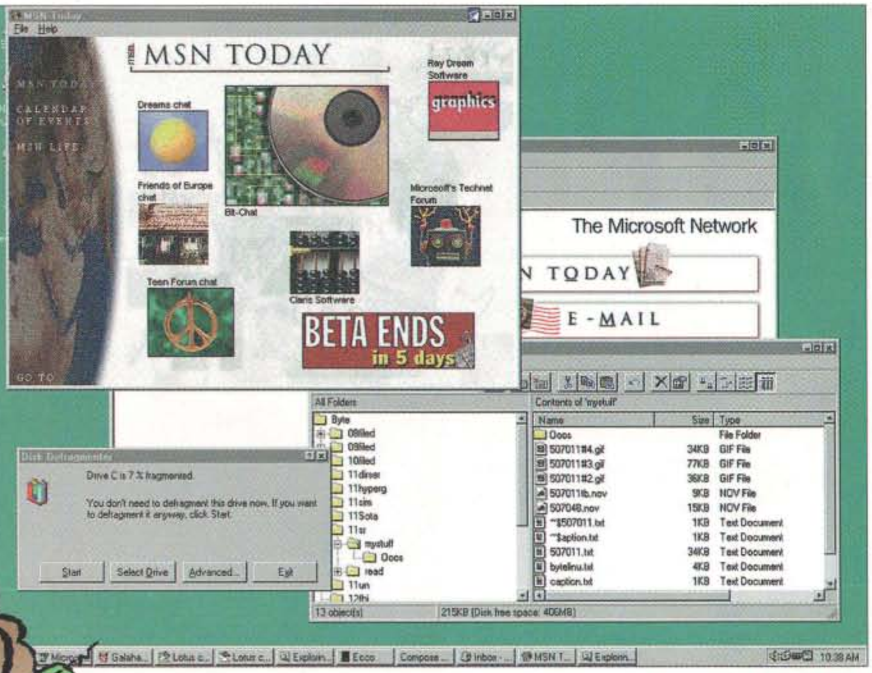
There are passing similarities to OS/2 as well, but key features of both the layout and the behavior of Windows 95 are strikingly NextStep-like. A totem-pole stack of icons for frequently accessed applications sits glued to the desktop. Across the bottom of the screen is a list of running applications with a graphical representation for each. Both graphical and text-based applications can be launched from the command line.

Critics have taken Microsoft to task for its continued dependence on 16-bit and DOS code. These same critics would have had even more to complain about had Microsoft abandoned so-called legacy applications and devices, those programs and peripherals supported under Windows 3.x but which have no 32-bit native equivalent.

A user of Windows 3.1 should quickly feel comfortable with 95's interface. Every aspect, from installation to application launching, is easier than under old Windows. The famous Start button unravels a cascade of menus which, depending on your preference, will either catch your fancy or annoy the daylights out of you. For the latter group, Microsoft has included a version of the much-maligned (and deservedly so) Program Manager called the Explorer.

The Windows user interface has gotten more than a cursory overhaul. (Some of the interface enhancements have been split out into a product called the Plus Pack, a $55 add-on.) The entire look is different, from window borders to mouse cursors. Font-smoothing drastically improves the appearance of larger text. When you resize a window, the window changes shape in real time. You can do a slow double-click on icon captions to change their names. Look-and-feel preferences now let you customize minute aspects such as the font used in title bars. Desktop Themes, including background images, colors, and font selections, can follow you around a network to make any machine feel like home. Even 16-bit Windows applications inherit Windows 95's look with regard to borders and common dialog boxes (e.g., "File Open").

TCP/IP support is standard, so if you're connected, you can use Windows 95 to run built-in apps and other Winsock (Windows sockets) software. Windows 95 also lets you connect to Windows for Workgroups and other NetBEUI LANs, as well as NetWare servers.



Drive C is 7 % fragmented.

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Name	Size	Type
Docs		File Folder
507011#4.gif	34KB	GIF File
507011#3.gif	77KB	GIF File
507011#2.gif	36KB	GIF File
507011tb.nov	9KB	NOV File
507048.nov	15KB	NOV File
~$507011.txt	1KB	Text Document
~$aption.txt	1KB	Text Document
507011.txt	34KB	Text Document
bytelinu.txt	4KB	Text Document
caption.txt	1KB	Text Document

Windows 95 is an operating system that's pretty easy to use and fairly powerful. But don't expect it to jump through all the hoops you expect Unix to go through.

Using OS/2 Warp

OS/2 Warp Connect has become a popular choice for the desktop. Before Windows 95 came along, OS/2 Warp was the best way to coax 16-bit Windows programs into multitasking more efficiently. You can run a high-speed modem session with a native Warp application (included in the Connect bundle) and support several Windows programs in the background without bogging down file transfers.

Most of these benefits pale in a field that includes Windows 95. OS/2 Warp can't run Windows NT or Windows 95 applications, and its user interface, while perfectly functional, looks industrial compared to the sleekness of Windows 95. That's sizzle, not steak, and so it may not figure into your consideration. Like Windows 95's Start button, Warp's Launchpad eases access to common functions by placing them a couple of clicks away. You may prefer the Launchpad to the Start button's incessantly cascading menu: Launchpad isn't quite as customizable, but it can save you digging through the Workplace Shell's deep hierarchies of icons for common functions.

Using OS/2 Warp to multitask Windows applications probably holds no appeal now that Windows 95 is out. It is worth running if you have even one critical native application. Warp also performs well as a nondedicated server for a Windows for Workgroups LAN; the demands of LAN print and file serving will take a lesser toll on a Warp machine than on Windows for Workgroups, and Warp's reliability is generally much higher.

The Warp Connect bundle, which includes many extra applications (a Web browser, for example), doesn't strike a decisive blow for OS/2 relative to Windows 95. Since most users have 16-bit Windows applications, they'll continue to run on whatever 32-bit OS they choose. IBM's bundling of personal productivity applications probably won't make a clear difference. IBM's anticipated shift to emphasize servers and vertical applications, areas where Big Blue has proven strength, should gain OS/2 more ground.

Using Unix

Unix is an odd market, primarily because it means so many different things. We chose to evaluate two System V Release 4 Unix products: Novell's UnixWare and SunSoft's Solaris x86. UnixWare went through some serious changes in release 2.0, gaining considerable maturity and stability in the process. Similarly, Solaris x86 version 2.4 cast off the yoke of prior releases, which were roundly criticized as buggy.

As with OS/2, Unix suffers a lack of major-label commercial applications. That has never been Unix's strong suit. Sites looking to put themselves on the Internet should think of Unix first. Most of the tools you need are free, and there's plenty of good help available when you get in a jam. Unix is also a mature and highly functional choice for application servers. Everything from accessing remote databases to executing remote applications can be handled by commercial Unixes.

Solaris and UnixWare rely on the X Window System for a graphical user interface. SunSoft and Novell each created their own file-manager shells that implement drag-and-drop capability and otherwise approximate the behavior of other popular GUIs. You can run graphical applications remotely: The remote machine, even hundreds of miles away, runs the software, but the interface is presented to you at your desk. Any PC or Mac running a popular OS can be adapted to work as an X Window terminal. In this regard, Unix offers the widest latitude of remote access as a standard feature.

UnixWare is a strong system with a workable graphical shell and a suite of well-designed graphical administration tools. As an application platform, UnixWare is a good distance behind Solaris, but only when you compare UnixWare with Solaris' implementation

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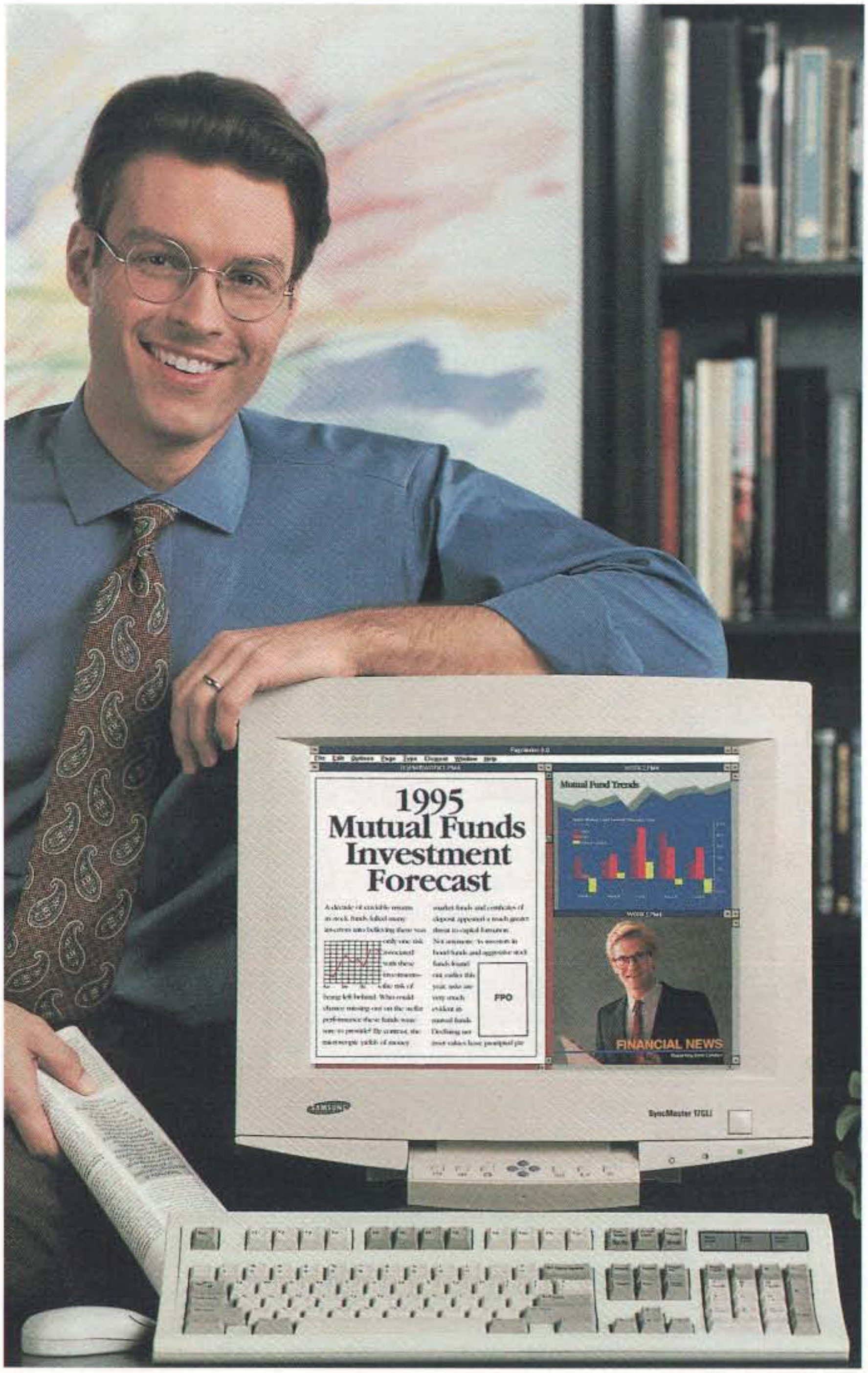

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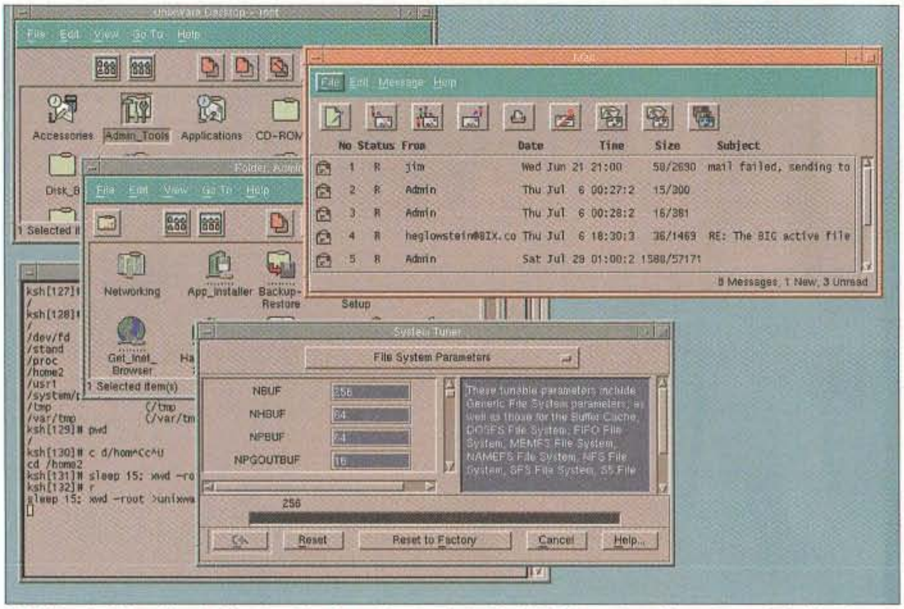


```
No Status From                Date             Time       Size      Subject
 1   R    jim                 Wed Jun 21 21:00            58/2690  mail failed, sending to
 2   R    Admin               Thu Jul  6 00:27:2          15/300
 3   R    Admin               Thu Jul  6 00:28:2          16/381
 4   R    heglowstein@BIX.co  Thu Jul  6 18:30:3          36/1469  RE: The BIC active file
 5   R    Admin               Sat Jul 29 01:00:2 1588/57171
```

8 Messages, 1 New, 3 Unread

```
ksh[127]
/
ksh[128]
/
/dev/fd
/stand
/proc
/home2
/usr1
/system/
/tmp                  (/tmp
/var/tmp              (/var/tm
ksh[129]# pwd
/
ksh[130]# c d/hom^Cc^U
cd /home2
ksh[131]# sleep 15: xwd -ro
ksh[132]# r
sleep 15: xwd -root >unixwa
```

File System Parameters

NBUF 256

NHBUF 64

NPBUF 24

NPGOUTBUF 16

These tunable parameters include Generic File System parameters, as well as those for the Buffer Cache, DOSFS File System, FIFO File System, MEMFS File System, NAMEFS File System, NFS File System, SFS File System, S5 File

256

UnixWare is Unix with a fairly attractive face. Front ends to the Unix file system, the system administration tools, and mail are built in. You will find yourself at a command line once in a while, though.

of the Motif Common Desktop Environment (CDE). CDE's front panel (see the screen shot below) nearly matches OS/2's Launchpad, but the front panel supports multiple workspaces. Each workspace is a full virtual screen, and you can switch from one screen to the next with the mouse or the keyboard. Solaris' CDE brings the X Window System up to consumer standards with enhanced E-mail, text editor, calendar, image editor, and other tools. CDE's new help facility compares well with Windows and offers hope that Unix developers may take advantage of this powerful standard.

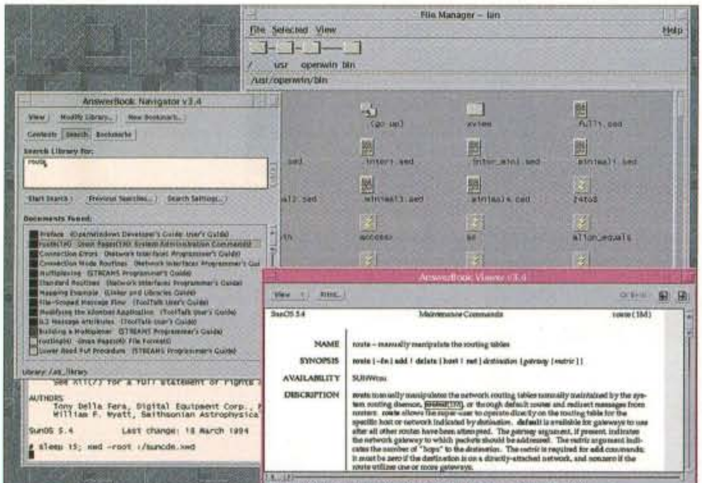
CDE's worth goes deeper than its glossy surface, and it isn't peculiar to Solaris. It's the product of the collaboration of Sun, Digital, IBM, Hewlett-Packard, and Novell. Solaris is the first CDE implementation we've seen.

Solaris has two unmatched features: Display PostScript (DPS) and Wabi. DPS enhances Solaris' OpenWindows X Window software with a full PostScript interpreter. You can view PostScript documents on-screen and even embed PostScript functions in your X Window programs. Solaris' documentation comes on CD-ROM in "AnswerBooks"—PostScript with embedded hypertext links. It's an effective combination, and it makes a good source for printing, too. And when it comes to running Windows applications on your Unix system, Wabi does quite well. Even enhanced-mode Windows applications run under Wabi, and SunSoft has done a good job of simplifying the work of installation. Wabi supports many popular mainstream software applications, but before adopting Wabi, first check the compatibility list to make sure that the programs you use are on there.

Administering Windows 95

Testing is the key to deploying a fleet of machines with a new OS. You may find that devices you favor aren't supported by your new OS. In our tests, an Orchid SoundWave 32 sound card was not supported by *any* of the tested OSes. A Sound Blaster 16 ASP card proved problematic in Windows 95 (reportedly fixed now), and even Microsoft's own Windows Sound System card produced no MIDI music.

Running a 32-bit OS requires a powerful system. Vendor recommendations can be used only as an optimistic baseline. One Microsoft spokesman referred to the claimed 4-MB memory minimum for Windows 95 as sufficient "unless you want to run real applications." A more realistic minimum is 8 MB. Our testing proved that 16 MB offers enough slack to minimize swapping in a networked environment with typical applications.



Solaris includes the AnswerBook, a very souped-up version of the `man` **pages. It also features the Common Desktop Environment (CDE), which is the "new" look and feel of Unix.**

Windows 95 Plus includes a 32-bit version of Microsoft's DriveSpace compression utility that can about quadruple the capacity of your hard disk. It's also flexible, letting you apply varying levels of compression to individual files or groups of files rather than to entire drives.

Windows 95 takes advantage of multitasking by introducing agents, programs that run in the background. With Plus installed, standard agents watch disk space, defragment your drives during off-hours, and implement DriveSpace's higher compression levels. The DriveSpace agent will also look for files that haven't been accessed in a specified number of days and compress them for you.

For administrators, an unpleasant aspect of Windows 95 is the VFAT file system. It gives you long filenames, but in most other ways, it's still the dumpy old FAT. Until native backup applications appear, you must resort to kludgey workarounds to reattach severed long filenames to their 8.3 DOS equivalents after a restoration from tape. VFAT also has no notion of file ownership or file-level access control, so real security is impossible to implement. If a user can get at a drive, local or remote, he or she can access every file on that drive. In our opinion, that puts Windows 95 completely out of contention as anything but a casual, completely open workgroup server.

Microsoft did itself proud, though, in redesigning the administrative side of Windows 95. You need to grab a copy of the Windows 95 Resource Kit. This chubby package explains everything the scant Windows 95 manuals don't, and the kit

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THE LINUX PHENOMENON

Linux is an amazing work: a robust operating system designed and written by far-flung groups of engineers, working for free. Recent attempts at commercialization notwithstanding, Linux is clearly the best 32-bit OS you can get for $25. Somewhat oddly, it seems to be attracting more development than commercial PC Unix systems, at least among those developers who contribute their wares to the public. And Netscape, that mother of all Web browsers, eschews all other PC Unix versions to run on Linux.

How good is Linux (and its counterparts FreeBSD and NetBSD)? Good enough, some think, to deserve use in critical applications. For example, Internet provider FastLane Communications operates on PCs running NetBSD. Like FreeBSD, NetBSD has its roots in code developed at U.C. Berkeley—code that is commonly used in commercial Unix releases, including System V Release 4. Linux borrows its networking innards from BSD, so in that regard, at least, it earns the right to be taken seriously.

For the Unix faithful, Linux and its BSD cousins have relit the flame that commercial software giants nearly extinguished. While purveyors of pricier Unixes for Intel-based PCs have failed to deliver a binary application standard, Linux has become a standard of its own. Big-name applications (except for Netscape) are lacking, but the Internet offers an abundant selection of tantalizing free applications. You may be frustrated by the lack of precompiled public applications for UnixWare or Solaris. Linux users suffer no such frustration. Indeed, most typical Linux distributions include four CD-ROMs packed full of software. And let's not forget the always-standard complete source code, which is at least educational and, for some, a glorious road to self-sufficiency.

Devotion Required

Defenders of Linux and FreeBSD/NetBSD reserve their most potent venom for those who suggest a noncommercial OS shouldn't be trusted for critical applications. Linux users in particular seem united in the belief that all commercial OSes are junk. Linux, they say, has gotten a raw deal in the Microsoft-cowed press. That's certainly true, but only to a limited extent. Linux and its BSD cousins still have some very rough edges. Getting the software installed isn't hard now that interactive install scripts are standard. Getting *past* that point, however, often calls for a hobbyist's devotion and love for long hours. Nearly all the Linux faithful are people who, if they couldn't rewrite the kernel in their sleep, could at least tell you where every key configuration file is squirreled away. That kind of skill takes time to acquire, and for Linux and FreeBSD and NetBSD, it is the minimum price of admission.

Perhaps that's as it should be. As one Linux aficionado put it, "If you don't understand how it works, and how to fix it when it's broken, you have no business using a computer."

includes three disks with management tools. Some tools, like the registry and policy editors, are included with Windows 95, but they're hidden away. Policies limit a user's access to resources and applications. You can restrict a user from accessing his or her Control Panel applets or modifying desktop settings. These policies can follow a user around a network, or you can create policies that keep all users of a shared machine from messing up the configuration.

Windows 95 connects, out of the box, to NetBEUI (Windows NT, Windows for Workgroups, LAN Manager, IBM OS/2 LAN Server), TCP/IP (including PPP and SLIP), and IPX/SPX (NetWare) networks. E-mail support is standard, and a unified in-box for fax, Microsoft Mail, Internet mail, and Microsoft Network mail is provided through an application called Exchange. The Plus package adds the Internet mail capability. Exchange's decision to reach into our UnixWare E-mail gateway and move (transfer and delete) all of the test user's E-mail was unexpected and unwelcome.

Windows 95 supports dial-up networking through Remote Access Server (RAS). The OS supports one dial-up client, so your users can set up their own modems to call their desktop systems for E-mail and remote networking.

Administering a network of Windows 95 systems is aided by the tools both in the OS and in the Resource Kit. It's made comparatively more difficult, however, because Windows 95 lacks both a competent shell language (for custom tools) and remote shell access. You can't easily send remote system commands through a network or dial-up connection. For that, you'll have to create your own tools, live with the limited access provided by Microsoft's standard tools, or buy Microsoft's System Management Server. Until native remote-access tools become available, managing a fleet of Windows 95 systems will be a hassle compared to OS/2 or Unix.

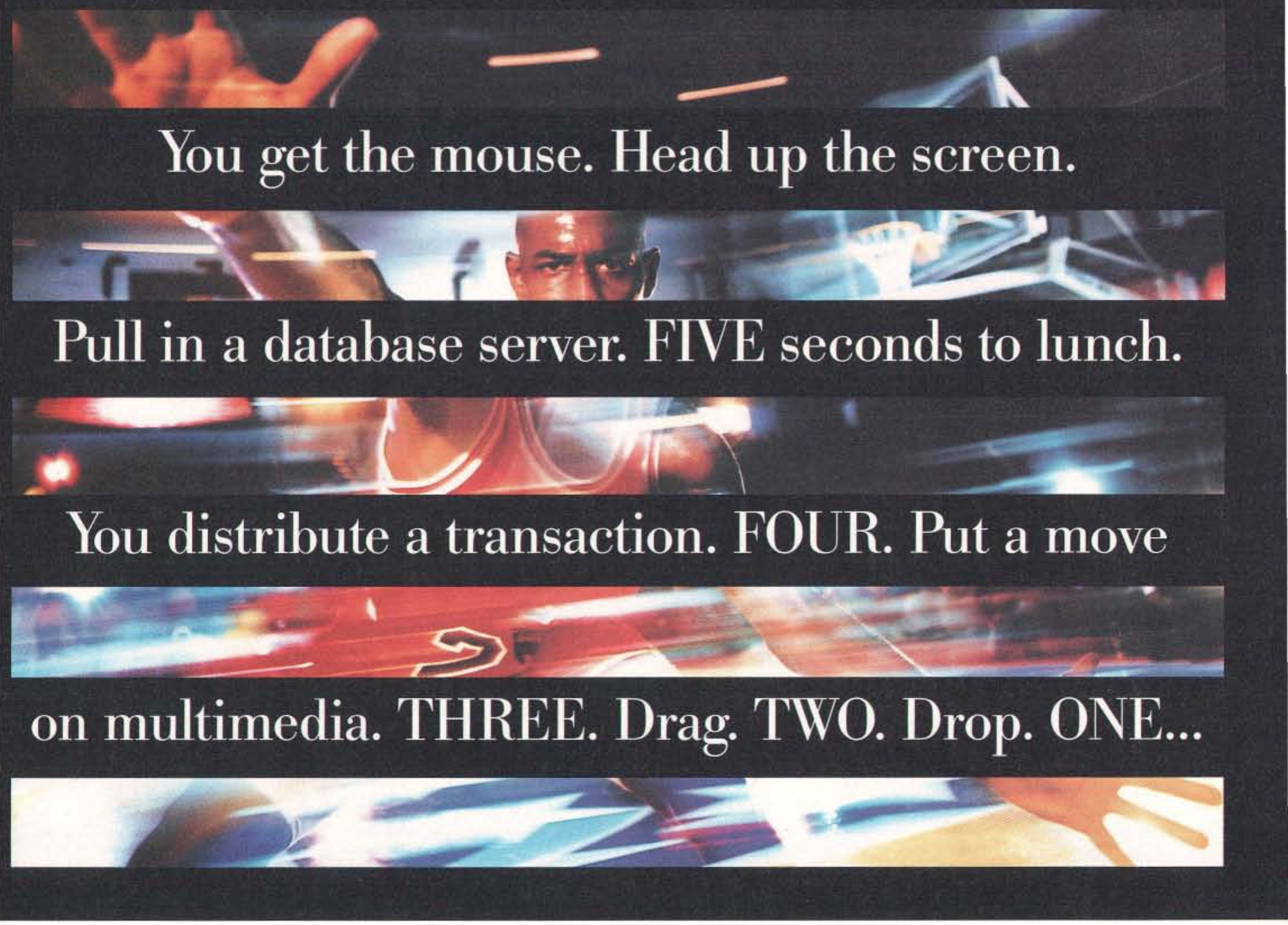
Administering OS/2

From a feature standpoint, OS/2 has most everything Windows 95 has except the ability to run the latest 32-bit Windows applications. Warp supports NetBEUI, TCP/IP, and NetWare networks. PPP and SLIP are standard. Tools for fax, Internet E-mail, and TCP/IP are standard. Network installation is supported. To its credit, OS/2 Warp also includes both a credible shell language (REXX) and the ability to run an OS/2 shell remotely through Telnet.

Unfortunately, OS/2's administrative interface starts to unravel when you set about configuring its many options. While Windows 95 keeps all its vital controls organized under the Control Panel, OS/2 spreads its administrative tools around. You must do quite a bit of hunting to bring together all the applications you need to get the system configured.

OS/2's implementation of TCP/IP is more complete than that in Windows 95, nearly rivaling Unix. Command-line tools, including essentials such as `nslookup` (name server lookup), are standard. If you have other TCP/IP applications you'd like to run, all of OS/2's supported modes (DOS, Windows, and OS/2) have network socket support. IBM includes code that adds socket support to the REXX shell language. Also, you can use OS/2 as a router or a gateway. IP forwarding is supported (unlike in Windows 95), and the OS handles up to seven network interfaces.

continued


You get the mouse. Head up the screen.
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What You See: What You Want?

User interfaces are in your face all day. What decisions go into—or should go into—their design?

DINAH MCNUTT

To read E-mail in one Windows application, you press Alt+M G. In another application, it's Alt+U R. And, in a third, Alt+B N. All pretty intuitive, right? Who thinks up these things, anyhow?

Graphical user interface (GUI) design is one of the most controversial aspects of software development. While few people might care how the application itself is programmed or what language is used, everyone has an opinion on the UI of an application. As a software developer trying to design a product, or as a customer trying to use what developers hand us, we all have been involved in interface design. And we have the mouse-scars to prove it.

Icons Rampant

The process of designing a UI varies depending on the size of the organization. At a small software company, it is all too common for the software engineers to design the interface themselves (usually on the fly), with predictable results. One example of this is a call-tracking system that had a call-logging option. When the user minimized the logging window, a crude bit map of a wooden log was displayed in the iconified window. One suspects an engineer quickly drew this icon to use during development, but it was never replaced with a production-quality icon in the actual product.

Other fingerprints that indicate engineers have had their fingers in the UI design are arcane technical terms used in the interface menus or commands. Often the display shows raw data instead of data in some format that might actually make sense to someone not already familiar with the information. For example, most Unix system administrators can easily recognize and parse the following data:

```
student:cOYWzzCDUrNP6:202:20:
Test Account:/users/student:
/bin/sh
```

This is a user entry from the system password file. But to the uninitiated, it makes more sense to display the information in the following way:

```
Login Name: student
Encoded Password:
cOYWzzCDUrNP6
User ID: 202
Group ID: 20
User Name: Test Account
Home Directory: /users/student
Interactive Shell: /bin/sh
```

Note that none of the information has been lost, but it is now displayed in a manner that both the seasoned system administrator and the novice user can understand.

Conversely, having someone who understands nothing about what the product does design the UI can be just as disastrous as the programmer-turned-interface-builder. Imagine a software package for accountants that does not use common accounting terms. No one with any accounting training would be able to use such a package. Novice users are probably going to have to learn the standard terminology anyway, so why invent terms no one knows just to make the product "friendlier"? Instead, the focus should be on the interaction of the user with the product.

Feast of the Unwarranted Assumptions

Never make assumptions about how your product will be used. People will always find new ways to use—and misuse, and abuse—your product. Search for beta testers who will stress your software in new ways and find out which parts of the interface work and which parts don't. These testers can also help you find new potential markets for your software. When they say, "What if when you clicked here it did this?" you may discover a whole new niche.

Another example: One product allowed users to schedule jobs off-hours. However, the designer built in assumptions about what a "normal" work schedule is and which hours are "off-hours." There was no technical reason for this limitation, so why impose one? Who needs a user interface to dictate their work schedule?

The Menu That Ate Cincinnati

Scalability is a prime area to focus on when evaluating an interface for usability. If a word processing package scrolls nicely for a 10-page document, how does it work for a 100-page, multidocument book? Vendors should design software that works well for both the low-end and the high-end user. A menu with 10 items is quite manageable, but what if there are 1000?

Try this, user interface designers: Multiply the number of items by 10 and then 100. Is the concept still usable? If not, see if you can come up with a different paradigm. For example, the interface of a checkbook program might work fine when the user is entering one or two transactions at a time. But some people, especially with joint accounts, write lots of checks. The software has to deal smoothly with a few checks or many checks each month. We would rather change our software than our way of life.

Understanding the Audience

Before the design process ever begins, identify an audience for the software. Keep in mind the level of expertise of the audience—and especially their expectations of the product. If the audience is diverse, you may need to decide which subset of the audience you are going to target. Then you need to rethink your marketing strategy to see if the product is still viable. Most operating systems, of course, have a "one-size-fits-all" interface.

Many system-administration

products offer only a GUI. This type of interface is great for novice administrators but tends to hamper more experienced administrators, who are used to command-line interfaces. In this particular market, it does not make sense to satisfy the requirements of only the senior system administrator, since one of the motivating factors for buying administration software at all is the ability to delegate tasks to more junior administrators. However, by *ignoring* the senior administrators and developing only the slick GUI for the novices, you may not be able to sell your product at all.

Wheels Reinvented Here

Many people come from backgrounds, such as Unix, where reinventing the wheel is frowned upon and reusing ideas is encouraged. But that philosophy should not apply to user interfaces. Even unimaginative implementors can appreciate good ideas. Only through innovative UIs can ubiquitous computing ever be achieved. What these interfaces will look like we perhaps cannot imagine, but we can imagine the useful things computers could do if they were more deeply integrated into our day-to-day activities.

Software and hardware design will both play factors in the role of UIs. The venerable keyboard-and-mouse combo is not always a practical way to use a computer. Both hardware technology and user demands for better interface designs should drive each other to improve the computing environment.

There was a time when it was unimaginable that anyone would need more than one window on a terminal. (When sharing a VAX 11/750 with 20 other people, this is probably true.) Now we may need several computers with many windows to do our jobs. In the same way, why should our computer interaction be limited by how fast we can type? Someday those limitations, and others we don't even recognize yet, will be removed. Now what will *that* interface look like?

In this and many other regards, OS/2 Warp combines the requirements of both desktop and server. Expect the coming Warp Server product to strengthen the server side with features such as disk mirroring and remote administration.

RAM requirements for OS/2 Warp start at 8 MB. Plan on 16 MB for a "power desktop" configuration, 32 MB if you're setting up a shared server. OS/2's device support is dated. It worked with the ET4000/W32 display card in our test machine, but only in interlaced mode with no manual override. You can override the system's modem selections, but that device list showed its age by leaving out V.34 models. Very few sound cards are supported, and the NE2000-compatible network card we used for testing required a driver from the vendor. It's essential you check the latest list of supported devices.

For supported devices, OS/2 seems smarter than Windows 95. When we changed the parameters for the network card, OS/2 queried the card and adjusted to the new parameters automatically. Windows 95 did not.

There are two more reasons to consider OS/2: its multiprocessor version and its coming support for the Power PC chip.

Administering Unix

It may take longer to learn to administer Unix systems, but once you've achieved the skills, you'll find the tools and capabilities of Unix unrivaled for many server applications. As we've mentioned, every variety of executable—line-mode text, full-screen text, and graphical—can be executed on any LAN, WAN, or dial-up node. UnixWare includes support for TCP/IP (with SLIP and PPP) and NetWare LANs. Solaris matches this, but it makes NetWare client support optional. NetBEUI support isn't standard, but a public-domain server called Samba runs on both UnixWare and Solaris. Clients must support NetBIOS over TCP/IP; check your clients' software.

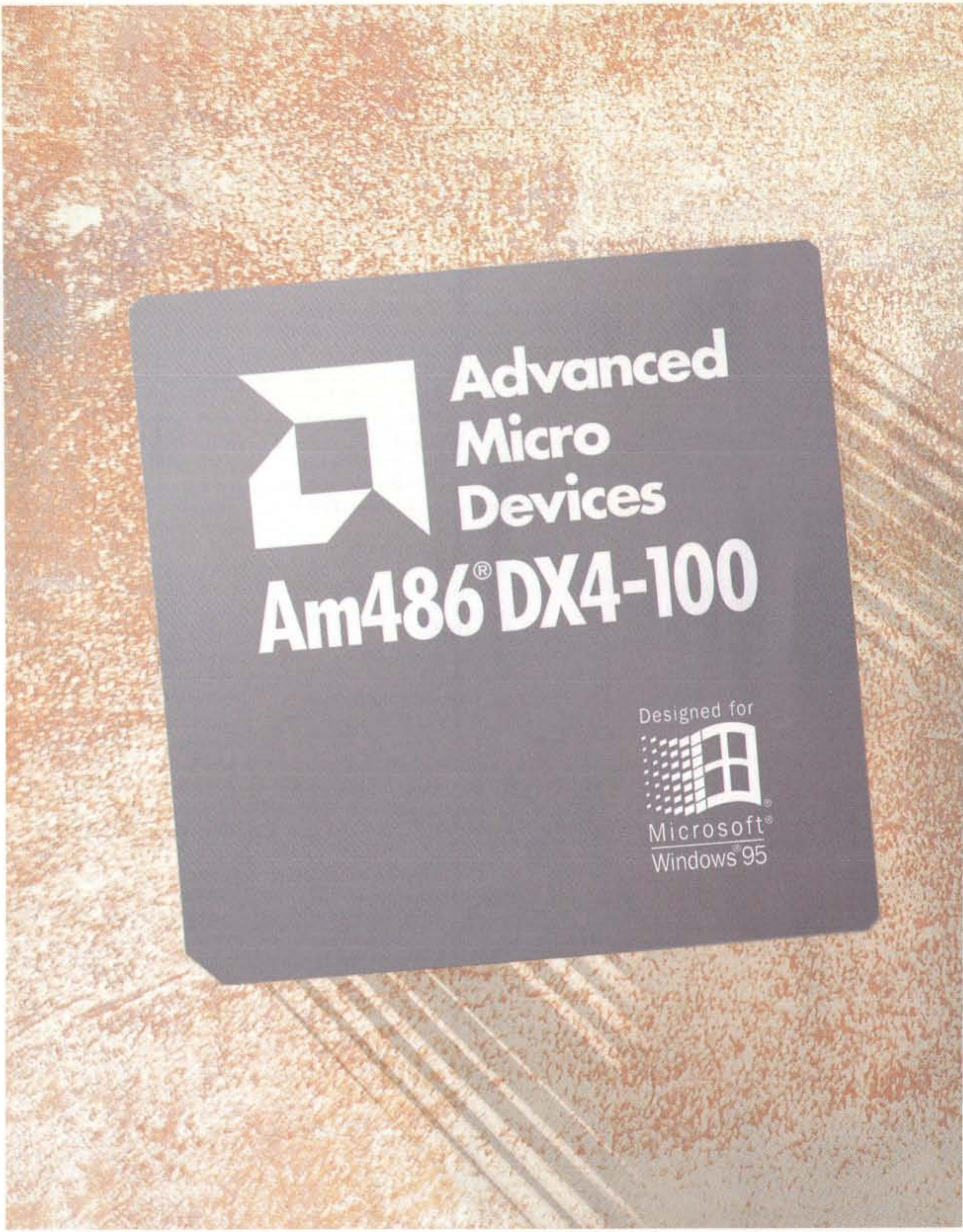
Don't be misled by all the talk about Novell merging UnixWare and NetWare: Novell currently has no NetWare server software that runs under UnixWare. Only client access is supported. Both UnixWare and Solaris do include NFS (the Network File System), and Solaris 2.4 (from Sun, which invented NFS) reportedly includes enhancements to NFS to improve performance. NFS has never been a top performer as a file-sharing system, but it is cheap to implement and easy to manage, and you can get NFS client software for all types of machines and operating systems.

UnixWare simplifies administration with a decent set of menu-driven tools. These tools are split between textual and graphical, but the most important functions are found in `sysadm`. This program's windowed textual interface makes fairly quick work of adding users, configuring dial-up lines, and other essentials. Solaris, inexplicably, discards this System V Release 4 standard in favor of its own graphical administrative tools. These tools, while prettier, don't cover the range of facilities covered by `sysadm`. Solaris administrators must navigate the jungle of command-line tools to do the work `sysadm` does for you in UnixWare.

UnixWare ships standard with a journaling file system from Veritas. Journaling limits loss of data on system failures and makes recovery after a power outage or other hard failure much quicker. You can purchase advanced file-system software for both Solaris and UnixWare to add support for striping, mirroring, spanning, and other server requirements. Unix has support for several installable file systems, all of which support ownership and detailed permissions. Most let you have long filenames and hard and symbolic links, or aliases for files and directories. Some Unix file systems support quotas, which track and limit each user's disk usage.

Machine requirements for PC Unix systems are comparatively steep, a strike against Unix as a desktop environment. We tested both Solaris and UnixWare on a Pentium 90 with 32 MB of RAM; amazingly, both suffered marked performance degradation when running a short stack of applications in a graphical environment. Solaris' performance hit was worse, but the CDE software was still in beta. If you plan to deploy PC Unix systems as servers, consider whether you really need to run the X Window interface. X eats RAM like crazy. Also, both UnixWare and Solaris automatically start NFS at boot time. You can save resources by turning NFS off if you won't use it.

Without the graphical environment, you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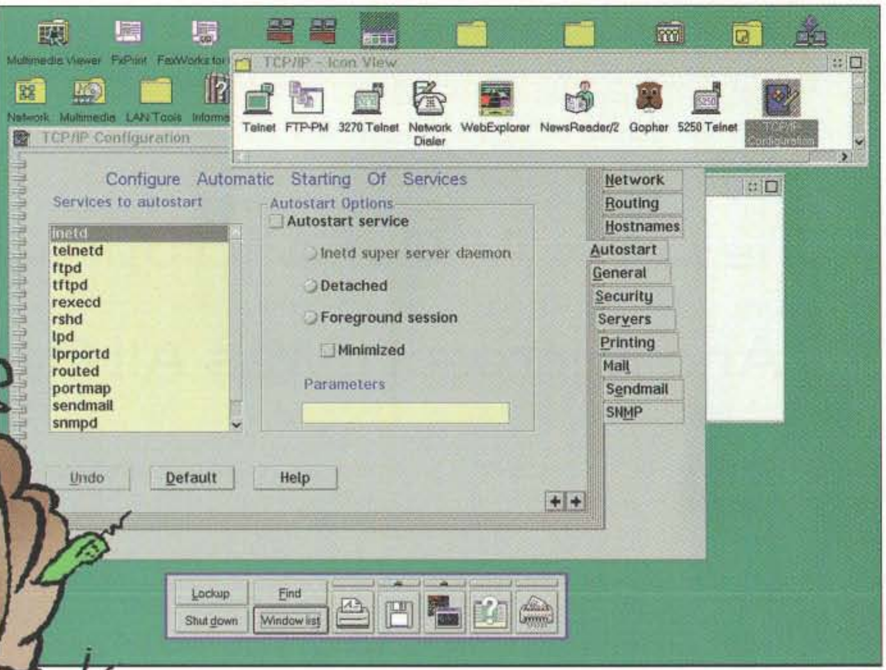


OS/2 Warp Connect comes with many useful network services—more, in fact, than rival Windows 95. But the user interface can sometimes be somewhat confusing.

should give both UnixWare and Solaris a minimum of 16 MB to 24 MB of RAM. With X Windows running, 32 MB becomes the minimum. If you don't often use the display, as with an unattended server, Unix will reclaim the memory occupied by unused graphical applications. Performance will be slower at launch, but it will improve as idle data gets swapped out of RAM.

Everything you need to put your site on the Internet, as a client or a server, is provided or freely available. Both UnixWare and Solaris work as gateways and routers if you have multiple network interfaces running. Both support demand-dialed PPP and SLIP for modem Internet connections, and both allow you to set up your modems to accept user log-ins, PPP sessions, and UUCP (Unix-to-Unix copy, a modem WAN variant). You can even pick up free fax software from several sites on the Internet. These Unixes work as DNS servers, and both support Sun's Network Information Service (NIS) for distributing user and network configuration databases among groups of systems.

Both UnixWare and Solaris have symmetric-multiprocessing support built-in.

Administering Windows NT

Windows NT Server 3.51 seems to have everything. While we're all bored to death with NT's user interface, which Microsoft plans to update with the Windows 95 look and feel, the services provided out of the box by Windows NT Server have no equal. TCP/IP, NetBEUI, and even AppleTalk are all standard. NT will act as a gateway to NetWare files and printers, and it will link multiple NetBEUI and TCP/IP networks as well. The administrative interface is clean and centralized, and the three-volume Windows NT Resource Kit gives administrators not only the essentials but a well-rounded schooling in the OS's internal structure as well.

Microsoft's NTFS file system delivers the advantages of UnixWare's journaling Veritas file system. It provides long filenames and POSIX-compatible links, as well as ownership and extensive permissions. Mirroring and striping are standard components of NTFS, with a simple, capable volume manager easing management of even huge numbers of drives. NTFS permits mirroring at the partition level, so mirrored pairs don't have to be of equal size. NTFS still uses backward FAT drive lettering, but striping makes it possible to combine multiple drives into a single lettered volume. Microsoft thoughtfully allows several versions of each file. This clears the way for uncomplicated handling of the Macintosh file system's resource and data forks, and it also lets you use the file system for versioning and on-disk archiving. Microsoft throws in a graphical backup utility that captures all this extra data.

Windows NT Server's power comes at a price: RAM. On our 32-MB test system, running TCP/IP, NetBEUI, and AppleTalk services together left only 6 MB of RAM free. If you run additional software, 32 MB might prove insufficient. However, if your machine is operating solely as a file and print server, 32 MB should be adequate. Once you start leaning on Windows NT's Unix-like strengths as an application server, plan to raise the bar to 48 MB or higher. While you might rely on virtual memory to provide headroom on a desktop system, it's a bad substitute for real RAM on a server.

We Live in a Political World

With all the hype and legal controversy swirling around Windows 95 at the time of its release, no one can deny that politics and marketing play as pivotal a role as technology in the OS market.

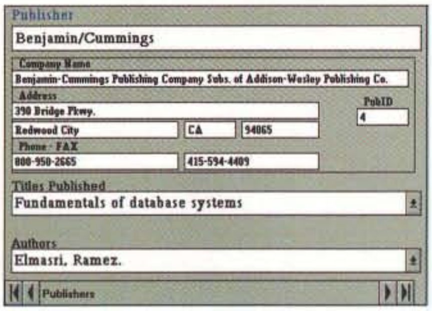
Microsoft hopes to secure more than just every desktop PC in the universe. The Redmond giant is aggressively pitching Windows NT as the premier server environment. The NetBEUI network protocol, now most often identified with Windows for Workgroups, can serve up files inside, while TCP/IP and SPX/IPX set up hooks to the outside. Meanwhile, Windows NT's user interface gets more Windows 95-like, showing Microsoft's intent to position NT for power desktop users as well.

Whether by luck or by design, Microsoft's strategy locks out other OS players. Commercial software developers must now target three systems—Windows for Workgroups, Windows 95, and Windows NT—each with its own foibles and strengths. Why write a compute-intensive application, for example, that doesn't take advantage of threads as supported by NT and 95? Meanwhile, can you afford to neglect the millions of Windows for Workgroups users who can't or won't upgrade? Developers wind up crafting specially tuned editions of the same code to run on two or more flavors of Windows. Then it all needs to be tested. Who has time for OS/2 or UnixWare?

IBM's OS/2 is, by the standards of most industries, a success. With some nine million copies sold worldwide (according to IBM), there are more machines running OS/2 than any other 32-bit OS. And IBM's OS/2 LAN Server is the second-most-used

Database Developer Productivity Comparison

Visual Basic



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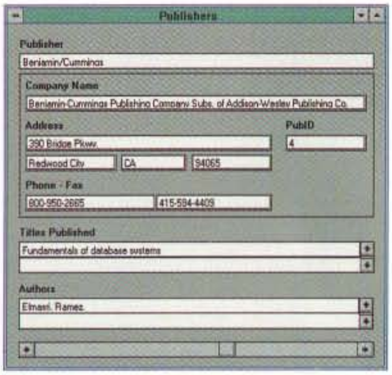
DataCtl(PubsList).RecordSource = SQL
DataCtl(PubsList).Refresh
Do While Not DataCtl(PubsList).Recordset.EOF
  PubsAuthors.AddItem
            DataCtl(PubsList).Recordset(0)
  DataCtl(PubsList).Recordset.MoveNext
Loop
If PubsAuthors.ListCount > 0 Then
            PubsAuthors.ListIndex = 0
End Sub
```

Oracle Power Objects



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DOING IT OVER

What happens when designers get a chance to build a second OS?

DINAH MCNUTT

Dave Cutler was the lead architect on Digital Equipment Corp.'s VMS, the operating system for minicomputers. Microsoft asked him to create Windows NT. Dennis Ritchie created Unix. Bell Labs put him in charge of Plan 9. Windows NT and Plan 9 are second children. Don't you wonder what it's like to get to design two major OSes? What do you learn? What do you do differently?

A Man with Nine Plans

To most Unix users or C programmers, Dennis Ritchie requires no introduction. He was one of the key developers of the first version of Unix 26 years ago at Bell Labs. He is the "R" in K&R C. Right now, he's head of Bell Labs Computing Techniques Research in Murray Hill, New Jersey, and for more than five years, he has been working with a team of nine programmers on a new OS.

The result is Plan 9. It was originally the brainchild of Ken Thompson and Rob Pike, but Ritchie played an active role by supporting the effort and helping to get Plan 9 out the door. The first version of Plan 9 was released last June.

According to Ritchie, Plan 9 takes many of the ideas from Unix and exploits them more fully. "Everything in Plan 9 is a file," he says. "Plan 9 encourages portability and machine-independent interfaces. Applications cannot tell whether they are running in a small personal computer or a large multiprocessor computer."

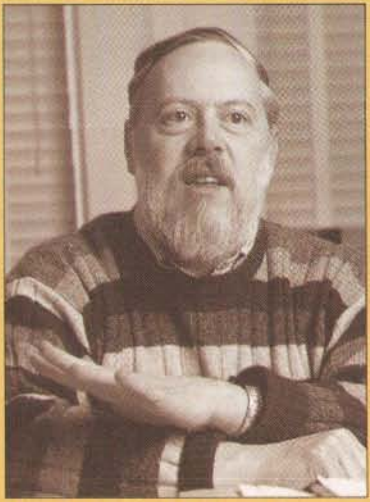
When asked about the biggest technical challenges in developing Unix versus Plan 9, Ritchie says, "On one level the technical challenge was the same—to find out how the machines really worked. That is, to get from the manufacturers a correct description of their hardware. Manufacturers really want to sell you a box with software and don't want you to write your own operating system. At a much higher level, the challenge is to create interesting abstractions and generalizations, like the notions of *file* in Unix and Plan 9."

Looking back, Ritchie notes that software development has changed a lot over the past 26 years. If he had to pick from the tools that he has now that he wished he had 26 years ago, they would be: "A windowing system. Fast communications. I won't ask for three wishes."

Besides the obvious changes in lower costs and increased computing power, Ritchie also cites the advent of networking, distributed computing, and good graphics as the biggest technical changes in software development. He also thinks the appearance of large independent software companies is the most significant nontechnical change.

Amazingly, Ritchie has few regrets about features that didn't make it into Unix and Plan 9. He says the more important release of Unix from his research group was the Seventh Edition, which strongly influenced AT&T's System III and V and BSD, but there aren't any features that they wanted to include and couldn't. His lab was doing work in networking and communications, and their research gradually influenced both flavors of Unix.

Ritchie's only regret regarding Plan 9 was that they could not include music on the Plan 9 CD-ROM. AT&T developed some proprietary algorithms for compressing digital music. Ritchie's group helped make these algorithms work on available hardware. They wanted to include the OS and several hours of music on the CD. The music would "sound like it came from an ordinary CD." Unfortunately, issues regarding the proprietary algorithms and the music itself prevented this from happening. "This had nothing to do with the Plan 9 system, but we thought it would be a lot of fun," he says.



Plan 9 did not come from outer space. It came from Bell Labs, with help from this man, Dennis Ritchie, one of the brains behind Unix.

Looking back, Ritchie is rightfully proud of Unix and what it's done. "The creation of a portable operating system and the consequent notion of open systems," he says, "I think this helped build an industry."

Asked what his expectations are for Plan 9, Ritchie responds, "They are modest. The ecological niche that Unix occupied is fully colonized and is now being overgrown by Windows of several varieties. The way we [in our research group] use Plan 9 is similar to the way that others use Unix or Microsoft's products, namely as a distributed development system with desktop machines and specialized servers. Whatever Plan 9's technological advantages, we don't have the resources to compete directly in this arena. On the other hand, there are plenty of more specialized areas involving embedded systems in which Plan 9's small size, portability, and technology might do well."

His expectations for Unix are just as modest: "As a product, it's certainly lost any chance to take over the mass market. As a standard, it will live for a long time."

Cutlering Edge

Dave Cutler is the head of the NT Development team at Microsoft. Before joining Microsoft, he played key roles in the development of RSX-11 and VMS at Digital Equipment Corp. In a rare interview, Cutler and his NT team answered questions on the past, present, and future of their OS.

NT and VMS are two very different systems, but they share similar technical challenges. "Both operating systems had rigorous compatibility requirements," the Cutler team says. "In the case of VMS, it was 16-bit programs that ran on RSX-11. In the case of NT, it was 16-bit Windows programs. The number of applications, the complexity of the programming environment, and the less-rigorously defined world of PC applications made NT's compatibility work orders of magnitude more difficult."

Technological changes have helped make NT possible. Faster processors have allowed for more sophisticated systems. "The time to rebuild the system after changes has dropped dramatically, allowing us to make changes and fix problems much more quickly."

In addition to faster processors, software tools are much different than they were 20 years ago. Given a choice of tools from the '90s to take back to the '70s, the team would choose the modern compilers. "They are far better at reliably generating good, solid, optimized code."

Despite the lack of robust tools, the initial release of VMS met the goals the team set out with. Multiprocessor support was on the wish list, but it was not a "killer" feature.

Cutler and his team used the experience with VMS to help make NT a successful project. With VMS, they learned on a similar but smaller-scale project what was essential to the process of building a system. They learned the requirements for applications, and how to design systems so they can be built incrementally. They also learned "why it's important to keep the system running throughout the process, from beginning to end. And how incredibly hard you need to work to make it happen."

The first release of NT was too slow and consumed more system resources than desired. NT 3.5 demonstrated a dramatic improvement in both areas. The team's goal is for NT to be an OS for desktops as well as servers. "When people use NT, they are consistently impressed by its robustness," according to Cutler's team. "Size and performance are critical areas that we constantly strive to improve."

The aspect of VMS for which Cutler is the proudest is the quality. "Minicomputers were used, from early on, by businesses to run their business. The systems had to run all the time, the applications protected from other applications' faults."

Despite all the technical challenges, one of the team's biggest problems may be the industry press. Media hype and criticism can cause additional stress on an already overworked team.

"It's difficult to predict when a system development will be complete. To begin with, the design is complicated; the problems are problems that are often new to the developers. Add to that a competitive environment that, at times, means changing the definition of the product during the development. Then the media apparently relishes announcing that a project is 'late' while the engineers are working as hard as they can to finish. It adds pressure to an already high-pressure situation. Then come the inevitable cycles of successive praise and condemnation of the product. That can often affect the morale of the team, particularly those who have not seen the cycles before."

The NT team is not done. Nor is NT: "When [NT''s] the predominant system on desktops and in networks, then we'll worry about the next project."

Dinah McNutt writes and teaches about system administration. She is a founder of Zilker Internet Park Inc. You can reach her at dinah@zilker.net.

network OS in the PC market. That's all according to IBM, but it makes sense: OS/2 was there when Windows 95 was not. Each slip in Microsoft's schedule signaled a predictable burst in sales of OS/2. Many IS managers got tired of waiting for an environment competent to drive the 100-MHz 486 and Pentium systems landing on desks.

While not conceding defeat on the desktop, IBM is busy remaking OS/2 Warp into a competitor of Windows NT. The dearth of native OS/2 applications would have eventually been OS/2's undoing in the broad commercial market. So IBM will focus on OS/2 Warp Server, a new product slated for release in the first quarter of 1996.

Commercial Unix and Unix variants have always been around to take up the slack. Failing (so far) to reach agreement on source-code compatibility, each Unix vendor still sells its special recipe. As it's impossible to write one piece of code that runs well on all Unix systems, most commercial developers choose not to bother. Interestingly, this problem doesn't exist on non-Intel Unix platforms, such as Sparc/Solaris, where the manufacturer (Sun) exercises tight control. We've seen something comparable with the Macintosh: Apple helps developers by imposing and enforcing standards on its systems. (There is such a thing as a benevolent dictatorship.) So most mainstream Unix applications, such as FrameMaker, are targeted for vendor-specific workstations (e.g., Sun) instead of PCs running Unix. That's not likely to change.

Commentators have frequently predicted the death of Unix, then marveled as it survives one seemingly fatal blow after another. A fanatical following is often credited, but other, more interesting factors are in evidence. Most of the better universities teach part, or all, of their computer curriculum with Unix as a foundation of study. It's easy to find skilled programmers and administrators among the ranks of college graduates.

Also helping Unix along is the Internet. All the information servers—FTP, Gopher, Archie, and the Web's Hypertext Transport Protocol (HTTP) among them—were born on Unix. In most cases, their most advanced implementations exist on Unix. TCP/IP, the unifying protocol that ties thousands of sites together via the Internet, started with Unix, and most TCP/IP networks have a Unix core. Being first doesn't ensure victory, but Unix made a name for itself as a server for everything from dumb terminal sessions to distributed objects. Even Bill Gates has admitted that Unix is a primary target for Windows NT development.

Where It Leads

Windows 95 blends a picture-postcard graphical interface with a fairly brainy OS. It provides good, but not foolproof, compatibility with 16-bit applications. Resources, while still limited, have been raised well above the limits imposed by 16-bit Windows. In short, Windows 95 is a good compromise: It fixes many of the things we hated about Windows, maintains reasonable compatibility with older applications, and, with the Plus option, adds worthwhile new functionality. It will certainly replace Windows 3.11 as the most popular PC desktop environment, and it just as certainly will maintain a solid lead in the quantity of available applications. Whether you think that lead is fairly won or not, Windows 95 is a safe bet for both users and developers. Administrators should arm themselves with the Windows 95 Resource Kit.

OS/2 Warp has grown to be the only credible competitor of Windows for Workgroups, even though IBM didn't add peer networking until the recent Connect bundle. It still has some clout, being a full 32-bit implementation and having a file system superior to Windows 95's FAT. If you're running any native OS/2 applications, or if you're developing your own code for in-house use, OS/2 Warp is worth a look. Until vendors get their Windows 95-certified applications out, Warp may still be a good way to mix 32-bit and 16-bit software. But that window is closing, and IBM is opening another one. OS/2 Warp, as it exists today, makes a great host for Lotus Notes, a BBS, or a small department server. The server edition of Warp, when it's released, should boost OS/2's file-serving power.

Windows NT Server presents administrators with a rare treat: a robust, self-contained server environment. It installs effortlessly; features central, graphical administration; and serves Mac, PC, and TCP/IP networks out of the box. NTFS is based on a marvelous file-system design, and the standard graphical volume manager simplifies management of complex array techniques, including striping and mirroring. Its weaknesses are the FAT-like drive-letter structure for disks and near-absolute dependence on graphical tools that make remote administration more challenging. Some POSIX (Unix-like) command-line tools are standard, and others are included in the Resource Kit, which, again, is a necessity for administrators. The re-made Windows 95 interface may help push Windows NT into Unix's accustomed niches.

That's assuming, of course, that Unix

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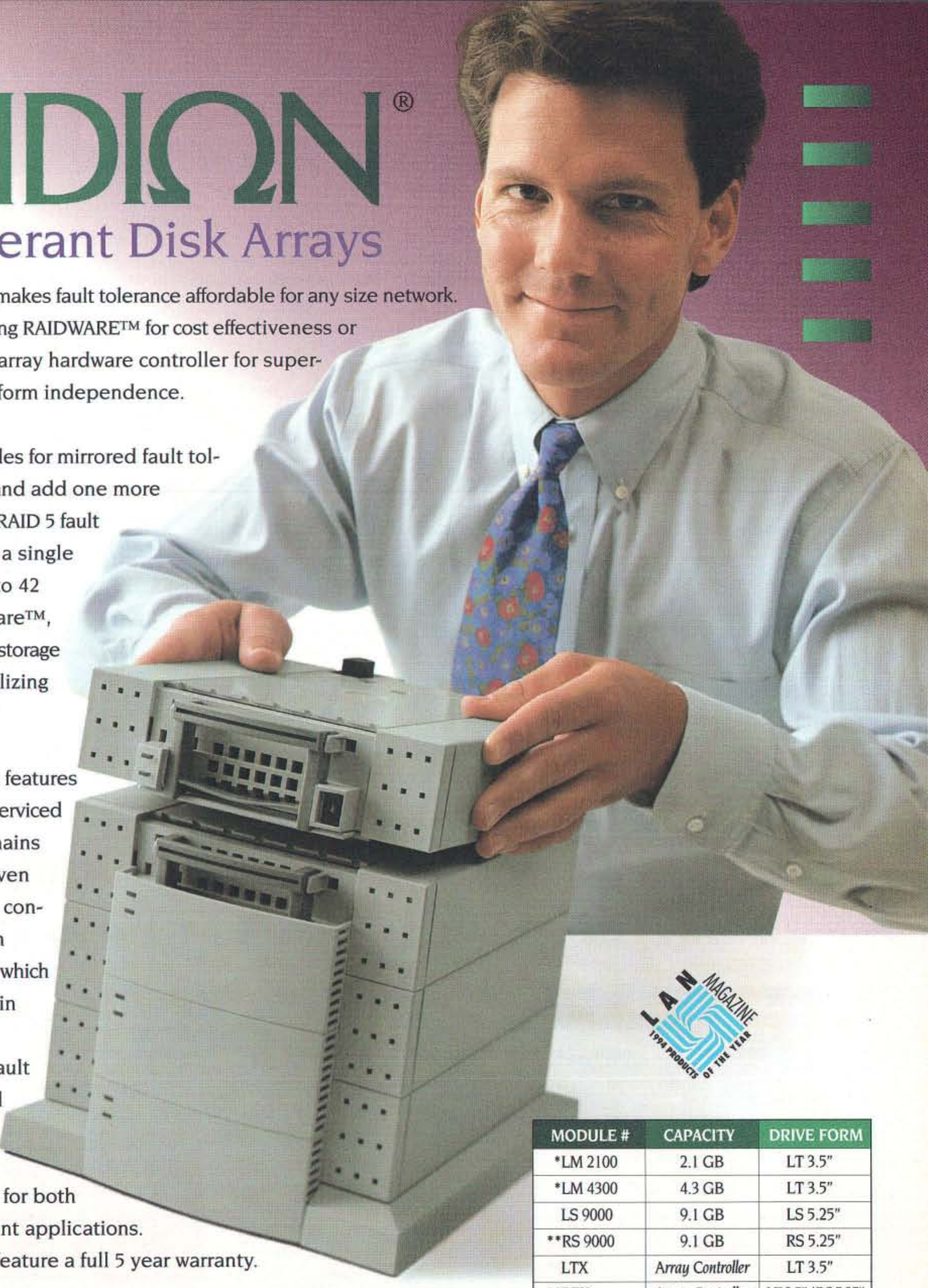

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NextStep: Pretty, Limited

The futuristic NextStep is a lovable mutt: a Carnegie-Mellon Mach kernel, BSD commands and libraries atop that, and a proprietary GUI that broke new ground at the time of its introduction. NextStep still has a unique look that's best summed up in one word: gorgeous. It's handily the most visually appealing OS for Intel-based PCs, thanks partly to the big, artistic icons. Unfortunately, NextStep hurts its appeal with limited device support and a decidedly proprietary approach. NextStep's fans hail mostly from those shops that can afford to create and maintain their own applications.

Like Solaris, NextStep has a built-in PostScript interpreter. It also includes other goodies like a lightning-quick 3-D rendering engine that you have to need to appreciate. Given a suite of custom applications, NextStep is an operating system you could sit in front of all day without going bug-eyed. X Window can't quite make that claim, but it is a standard.

doesn't advance just as quickly.

After working with UnixWare 2.01 and Solaris x86 2.4, we find that Unix is still just as worthwhile for that which Unix has always done well: If you want to put data—terminal sessions, files, objects, you name it—on a network, Unix remains an obvious choice. But it's still not for the faint of heart. An administrator with scant knowledge of Unix will find OS/2 Warp and Windows NT easier to install and maintain. However, once learned, Unix's standard tools and quaint (but effective) ASCII configuration files ease administration in ways no other server environment can match.

The Common Desktop Environment look-and-feel you get with SunSoft's Solaris adds some sparkle to what was becoming a millstone around Unix's neck, the comparatively ugly X Window System. Ugly though it is, X Window's standard ability to run all classes of applications remotely, even through WAN links, endears X and Unix to builders of enterprise networks.

One of life's certainties is the inevitability of change. Maybe what you're running now is doing the job for you. But in time, perhaps soon, you'll find yourself forced to choose from among the field's 32-bit players. We hope we've given you a healthy head start on the homework you should do before settling on the OS you'll run for the next several years. ■

Tom Yager used to be a BYTE technical editor covering Unix and multimedia. Now he's a freelance writer and consultant who runs his own research lab in North Texas. You can E-mail him at tyager@maxx.net.

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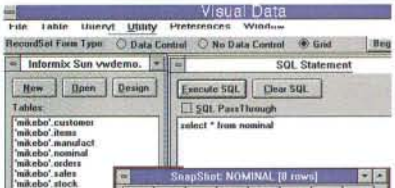

'mikebo'.customer
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'mikebo'.orders
'mikebo'.sales
'mikebo'.stock

```
select * from nominal
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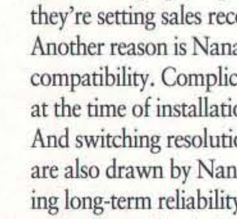

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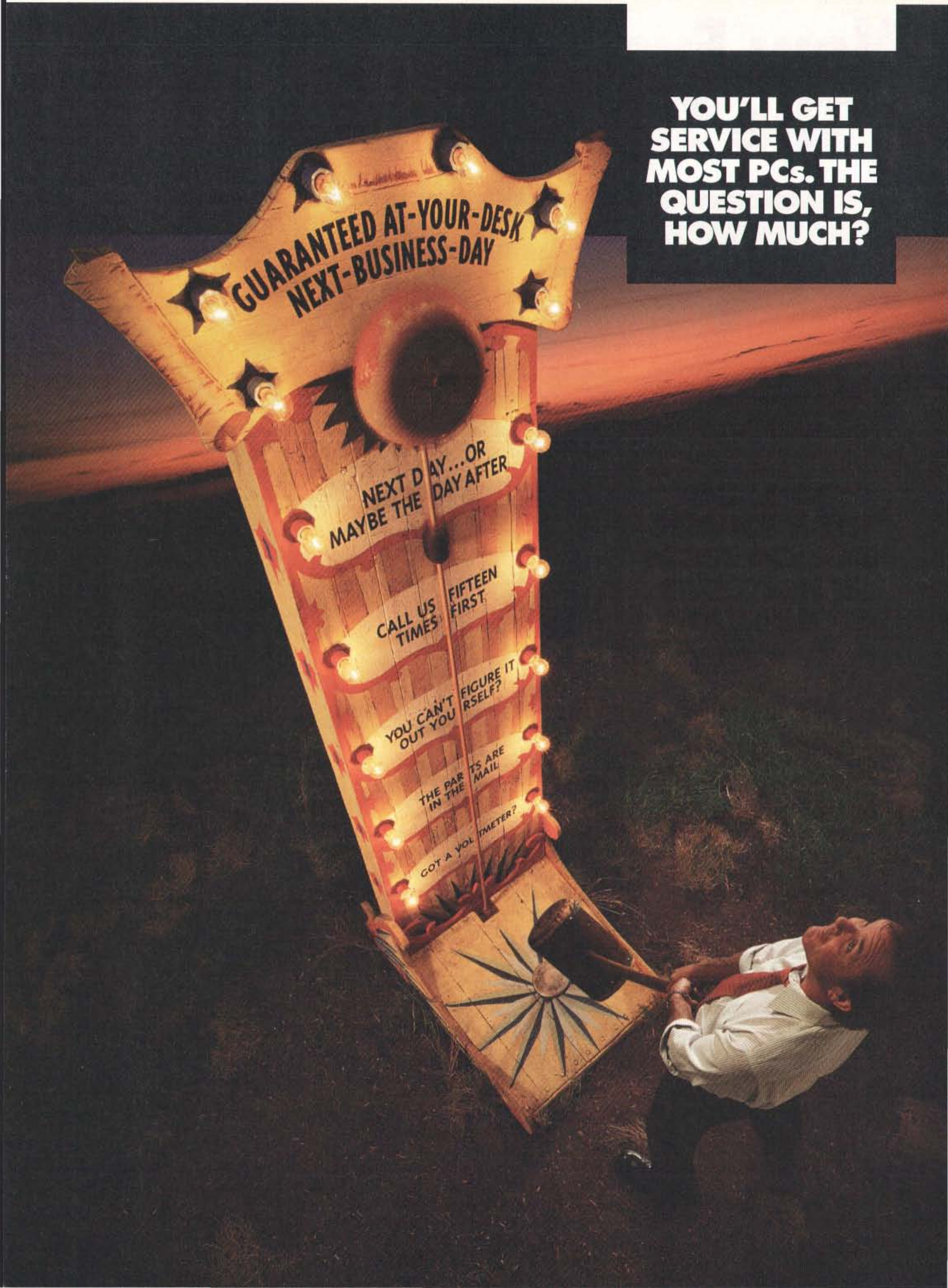

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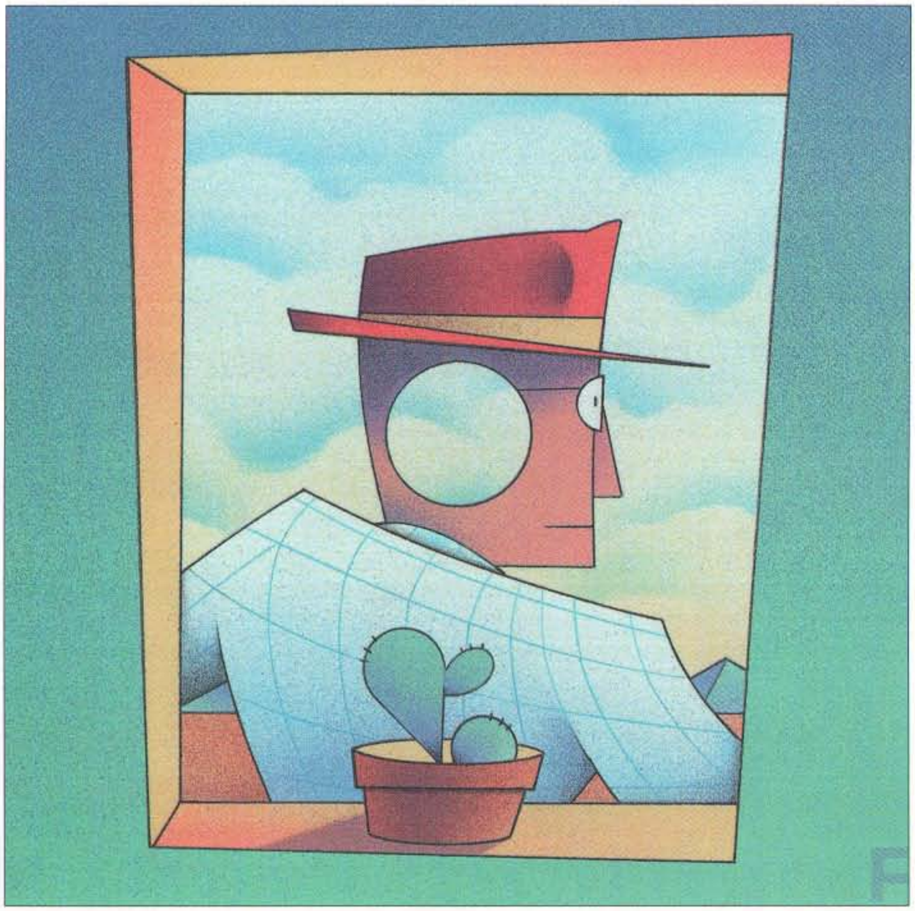


MARK FISHER © 1995

Utility programs provide functions left out of an OS, and the best ones become part of it

No desktop operating system is ever complete, and Windows 95 is no exception. Utilities, whether an OS vendor ships them in the operating system or an independent software vendor develops them, play a primary role in the growing and changing expectations we have of operating systems. Some make more efficient use of hardware, such as memory and storage, while others improve (or at least change) the user interface. Utilities may help the system as a whole run faster, or add features that were left out of the OS itself.

The first DOS utilities, packaged with the OS, were simple tools. Two of the most important were Format and Edlin, essential for formatting a disk and editing a (small) file. Even then, however, third-party developers were producing extensions. PC Tools let you recover damaged disks or examine and modify the contents of physical disk locations. Norton Utilities let you unerase an inadvertently deleted file. Quarterdeck Office Systems, with Desqview, added one of the first multitasking shells to DOS, taking advantage of the 386 processor. Norton Commander was for many years a popular way to navigate the directory structure of DOS.

Why Utilities?

The obvious question about OS utilities is why they exist at all. If they are as useful as they seem, why aren't they included as part of the operating system? The answer varies depending on the utility, the OS, and their vendors.

First, utilities may fill a hole in the OS that no one knew existed until the OS got widespread use. One example is DOS 6.2's ScanDisk utility, which examines the structure of a compressed disk: Without disk compression itself, there was not much demand for ScanDisk.

Second, most users might not need the utility. If only 5 percent of all users would need a utility (such as the system-usage monitor provided by Norton Utilities' System Watch), it makes little sense to invest the development time to build it into the OS and then require the additional computer resources to run it.

Utilities are a test bed for new OS technologies. If they are popular enough, they or similar tools may appear in the next major release of the OS, or in an entirely new OS. Microsoft incorporated many third-party utilities—ones for managing memory, for example, or for undeleting files—into DOS 5.0. Qualitas, Quarterdeck, and Norton (subsequently acquired by another utility giant, Symantec) had these utilities long before Microsoft.

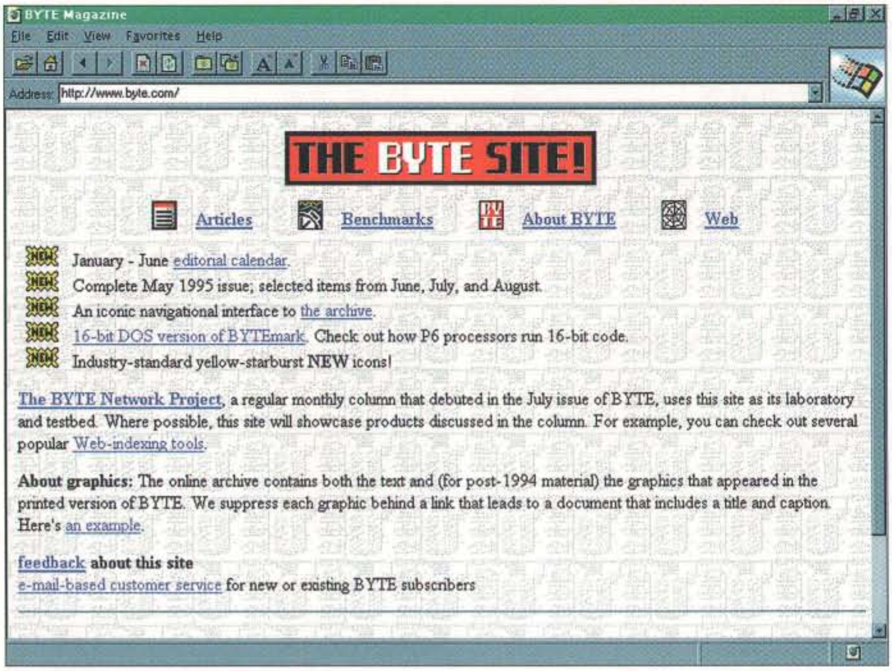
Utilities for Windows 95

What has Microsoft included in Windows 95 that was not a part of its previous OS, and why? And an important follow-up question: What is left for utilities vendors to build?

The initial cynical response to that last question might be "not as much as there used to be." Windows 95 includes a better user interface and a better file manager/navigator, which can make interface shells such as Norton Desktop redundant. However, the increasing complexity of OSes brings out the need for more and different utilities.

Microsoft itself is shipping a companion set of utilities to Windows 95, called Microsoft Plus for Windows 95. Microsoft designed Plus to do two things: make the PC run better and make the user interface look better. In the "run better" category, the package provides utilities for system and disk maintenance, such as compression and defragmentation. The "look better" tools include Desktop Themes, which lets you load special background wallpapers and accompanying sounds, mouse pointers, colors, and other cosmetic changes, plus font smoothing and wallpaper stretching. There's also an Internet navigator, which provides graphical access to World Wide Web sites. For all-important leisure activities, Microsoft Plus includes a new 3-D pinball game.

So why aren't these same features in the base OS itself? Well, they are, but not to the same extent as provided by the Plus package of utilities.



January - June editorial calendar.

Complete May 1995 issue; selected items from June, July, and August.

An iconic navigational interface to the archive.

16-bit DOS version of BYTEmark. Check out how P6 processors run 16-bit code.

Industry-standard yellow-starburst NEW icons!

The BYTE Network Project, a regular monthly column that debuted in the July issue of BYTE, uses this site as its laboratory and testbed. Where possible, this site will showcase products discussed in the column. For example, you can check out several popular Web-indexing tools.

About graphics: The online archive contains both the text and (for post-1994 material) the graphics that appeared in the printed version of BYTE. We suppress each graphic behind a link that leads to a document that includes a title and caption. Here's an example.

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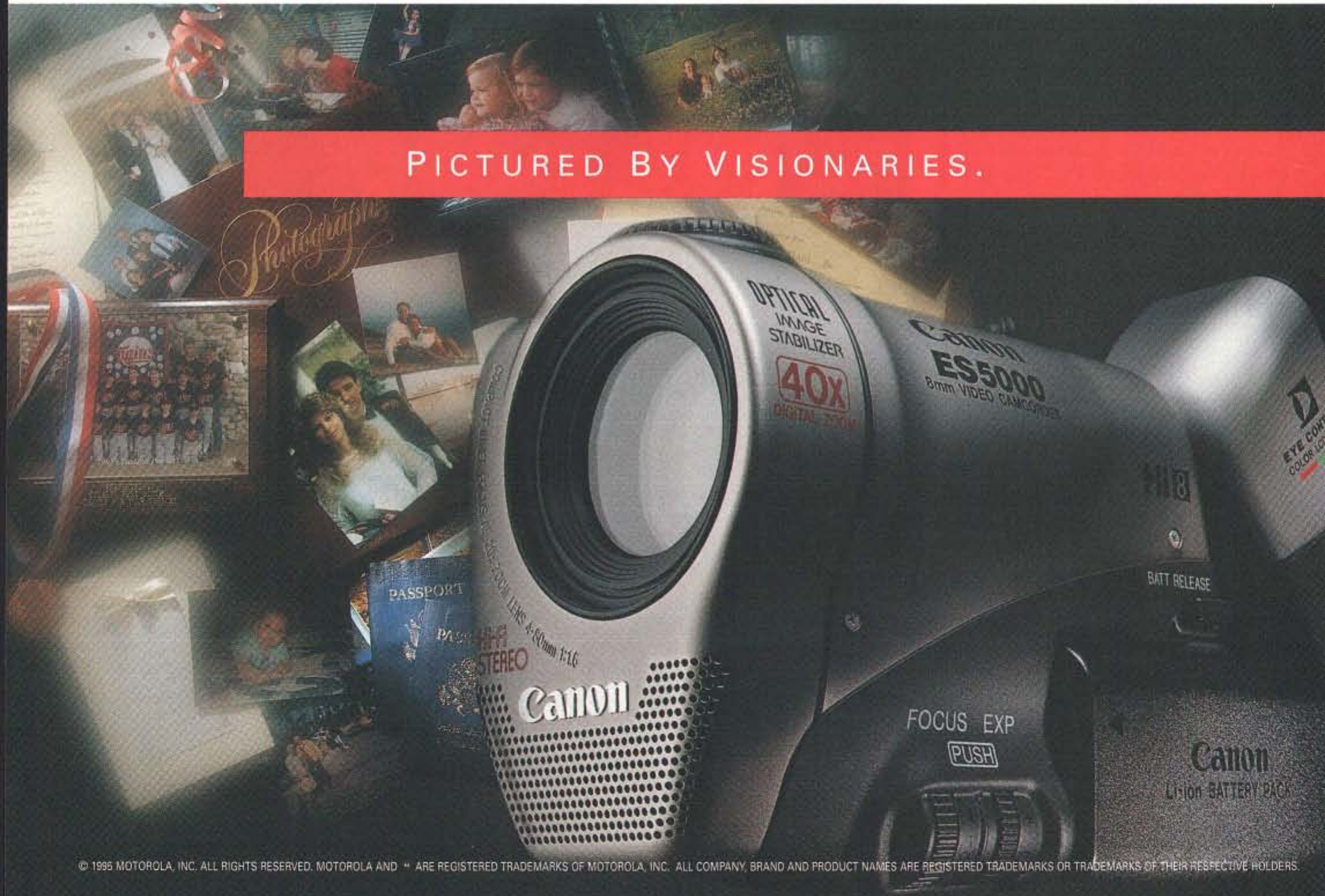
Microsoft's own Internet Explorer utility, included in Microsoft Plus for Windows 95, provides GUI access to the Internet and the World Wide Web.

According to Alec Saunders, Microsoft Plus product manager, the first goal of these utilities is to make Microsoft money. Fair enough. However, in differentiating these particular utilities from Win 95 it-



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What the Other OSes Forgot

DOS, which for many years provided basic operating system services with few extras, bred hundreds of successful utilities. Norton Utilities and PC Tools offered suites combining several utilities that gave users finer control over their computers. Quarterdeck and Qualitas provided better memory management, especially once the 386 made memory more accessible.

Windows 3.0 and 3.1 opened up more possibilities for utilities. With large Windows files—and disk space at a premium—Stac Electronics' DoubleSpace utility quickly became a standard for disk compression (which almost as quickly got integrated into DOS 6.x). Windows 3 was not the best at managing memory. Quarterdeck jumped in and adapted QEMM to handle memory under Windows. Windows' adequate but uninspired Program Manager spawned an industry of Windows shells, with Norton Desktop the leading alternative.

The Macintosh OS has also been a fertile breeding ground for utilities. Many began their existence as desk accessories, enabling users to search for files (Norton File Find), defragment the disk (Norton Disk Defragment), and recover damaged disks (Central Point's Mac Tools). Norton Utilities and Mac Tools made many PC-type utilities available for the Macintosh.

Few utilities have tampered with the look and feel of the Mac OS, however, primarily because Apple has always published and enforced user interface standards that have precluded alternative desktop managers or shells. Mac utilities have largely focused on providing the users with better access to hardware or OS internals.

Running Multiple OSes

For those who run multiple operating systems from the same PC, V Communications' System Commander is an indispensable utility. System Commander lets you load and boot from any of several OSes, such as DOS, Windows 3.1, Windows NT, Windows 95, and OS/2—on different disk partitions or on the same partition. It will even work with an OS, such as Win 95, that requires installation on the boot sector of the disk. Boot-management utilities such as this are, in effect, OS-independent, giving the user ready access to any PC operating system.

And NOSes Too

Even network OSes use utilities. For example, Novell's NetWare has a companion product called LAN WorkPlace. LAN WorkPlace, like part of Microsoft Plus, is an Internet access facility that includes the Netscape Navigator for graphical browsing. This points out the growing need for a class of utilities that operate with the NOS, just as most of the popular utilities work with the desktop OS.

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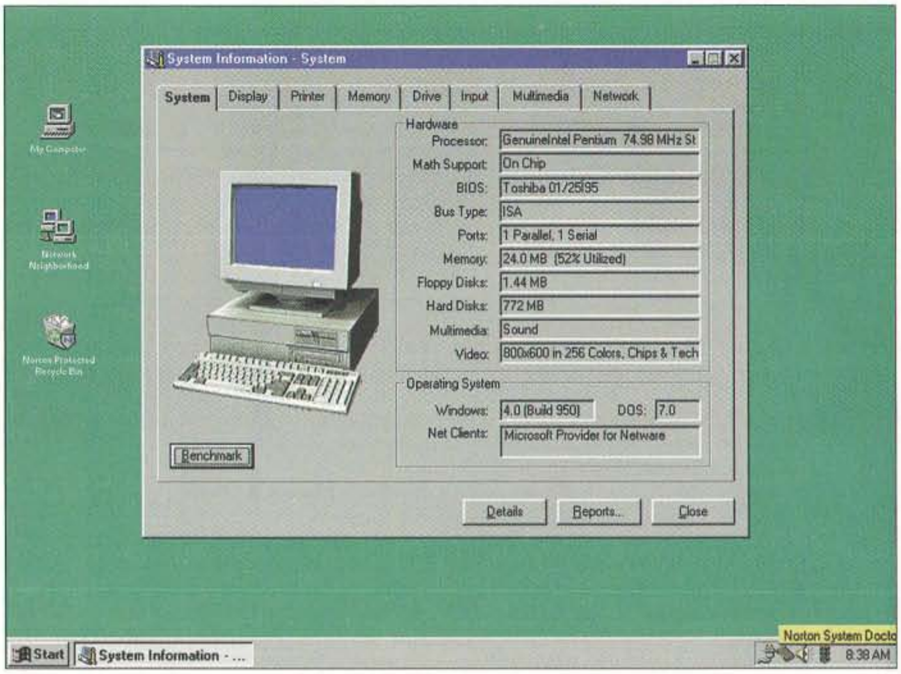
self, Microsoft used performance and system resources as the deciding factor. For instance, the base Windows 95 is advertised to run on a 386 PC with 4 MB of memory, thus fulfilling a Microsoft promise to make the new OS work on many older systems. For more powerful systems, Plus enhances both operation and appearance. As an example, Saunders cites the Plus disk compression algorithm; it's optimized to run on the Pentium processor. Likewise, the wallpaper used in Desktop Themes looks and performs best with high-end graphics adapters and graphics acceleration. All these utilities *will* run reasonably well on slower systems (such as the 33-MHz 486 used to test Win 95 and Microsoft Plus for this article). However, power users running a Pentium PC with a graphics accelerator will find that the Plus utilities improve many aspects of system use without degrading performance.



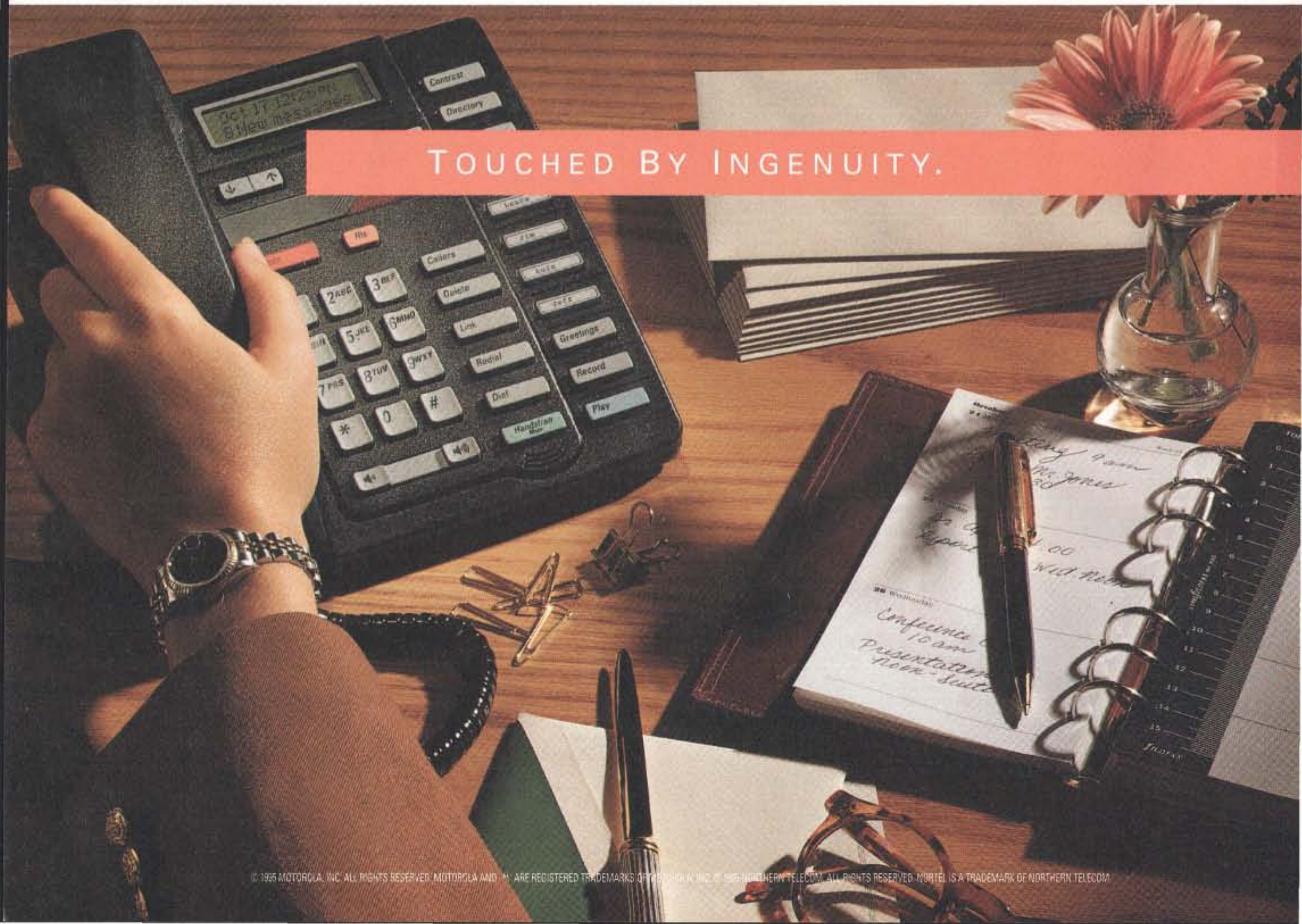
Hardware
Processor: GenuineIntel Pentium 74.98 MHz St
Math Support: On Chip
BIOS: Toshiba 01/25/95
Bus Type: ISA
Ports: 1 Parallel, 1 Serial
Memory: 24.0 MB (52% Utilized)
Floppy Disks: 1.44 MB
Hard Disks: 772 MB
Multimedia: Sound
Video: 800x600 in 256 Colors, Chips & Tech

Operating System
Windows: 4.0 (Build 950) DOS: 7.0
Net Clients: Microsoft Provider for Netware

Norton's System Information tells you all about your PC, including BIOS, memory, and video.

System Agent, Man

An important feature of Microsoft Plus is the System Agent, along with other affiliated agents. According to Saunders, Microsoft developed the System Agent to improve disk compression. The agent uses a "lazy compression" algorithm, meaning that it waits for idle system time and then compresses files. To do this, Microsoft needed a way of determining when the system is idle, and the System Agent was



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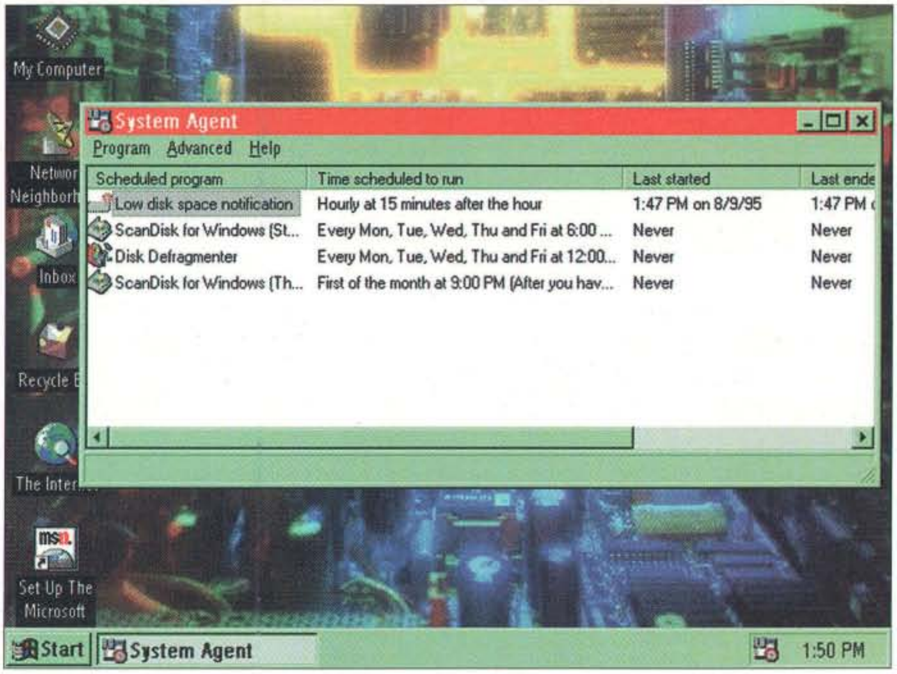

Scheduled program	Time scheduled to run	Last started	Last ende
Low disk space notification	Hourly at 15 minutes after the hour	1:47 PM on 8/9/95	1:47 PM
ScanDisk for Windows (St...	Every Mon, Tue, Wed, Thu and Fri at 6:00 ...	Never	Never
Disk Defragmenter	Every Mon, Tue, Wed, Thu and Fri at 12:00...	Never	Never
ScanDisk for Windows (Th...	First of the month at 9:00 PM (After you hav...	Never	Never

Windows 95's System Agent allows you to schedule actions, alerts, and program launches by time and other conditions. System Agent may represent a whole new area of smart Windows utilities.

born. It uses preprogrammed rules to detect when the system is not doing anything and cues the disk-compression utility to start squeezing uncompressed files.

The System Agent uses the same criteria to schedule defragmentation, backup, and scan-disk activities. Agents can also control the launching and running of applications. If an application requires little or no user interaction, the System Agent can schedule the application launch and make sure it completes properly. Applications have to be "System Agent-aware" to receive this kind of service, and Microsoft includes an API that applications can call to do just that.

Third-Party Survival Tactics

Microsoft has a business group for working with third-party developers—including utilities developers—for Windows 95. According to Deborah Epstein-Celis, a product manager with Microsoft's third-party software group, Microsoft attempts to build a base level of features into the OS and then counts on utilities to round out the less basic needs of diverse groups of users. Many of these utilities are pioneered and marketed by other vendors, some in direct competition with Microsoft.

Symantec's Norton division released Norton Utilities for Windows 95 concur-

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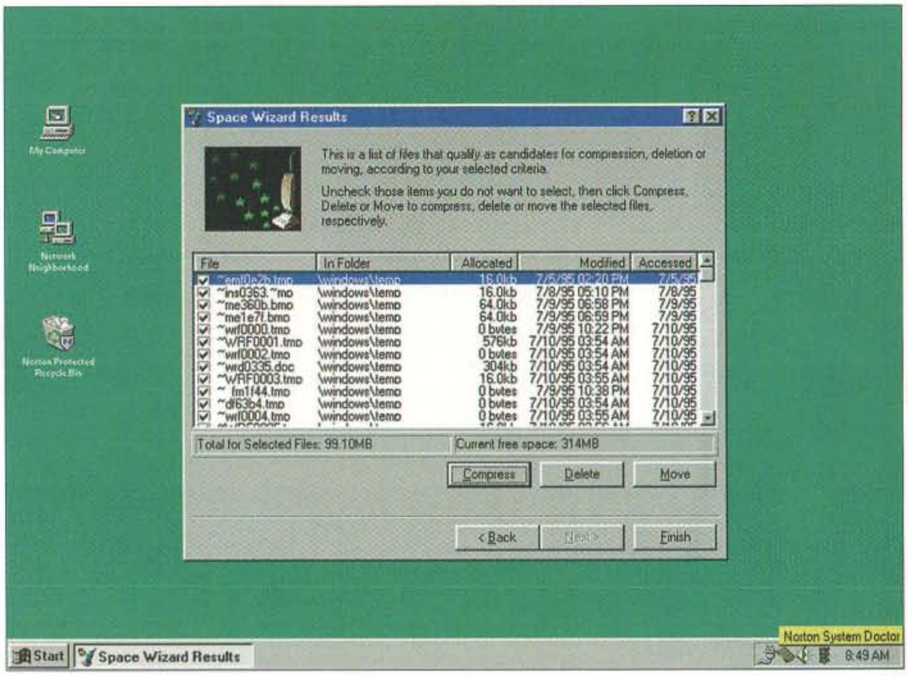


Space Wizard Results

This is a list of files that qualify as candidates for compression, deletion or moving, according to your selected criteria.

Uncheck those items you do not want to select, then click Compress, Delete or Move to compress, delete or move the selected files, respectively.

File	In Folder	Allocated	Modified	Accessed
☑ ~emf0e2b.tmp	\windows\temp	16.0kb	7/5/95 02:20 PM	7/5/95
☑ ~ins0363.~mp	\windows\temp	16.0kb	7/8/95 05:10 PM	7/8/95
☑ ~me360b.bmp	\windows\temp	64.0kb	7/9/95 06:58 PM	7/9/95
☑ ~me1e7f.bmp	\windows\temp	64.0kb	7/9/95 06:59 PM	7/9/95
☑ ~wrf0000.tmp	\windows\temp	0 bytes	7/9/95 10:22 PM	7/10/95
☑ ~WRF0001.tmp	\windows\temp	576kb	7/10/95 03:54 AM	7/10/95
☑ ~wrf0002.tmp	\windows\temp	0 bytes	7/10/95 03:54 AM	7/10/95
☑ ~wrd0335.doc	\windows\temp	304kb	7/10/95 03:54 AM	7/10/95
☑ ~WRF0003.tmp	\windows\temp	16.0kb	7/10/95 03:55 AM	7/10/95
☑ ~ fm1f44.tmp	\windows\temp	0 bytes	7/9/95 10:38 PM	7/10/95
☑ ~df63b4.tmp	\windows\temp	0 bytes	7/10/95 03:54 AM	7/10/95
☑ ~wrf0004.tmp	\windows\temp	0 bytes	7/10/95 03:55 AM	7/10/95

Total for Selected Files: 99.10MB

Current free space: 314MB

Norton's nifty Space Wizard helps free up room on your hard disk and clear up clutter in the process.

rently with Microsoft's release of the OS. Norton Utilities includes tools, such as Disk Doctor and Disk Edit, that have become standard fare for power users trying to get the most from their PCs. The Norton Utilities for Windows 95 contains many of the same utilities found in previous versions, including a "safe" format and a system information reader. These are supplemented by Space Wizard, a system diagnostics utility, and the System Doctor. The System Doctor monitors system resources, including CPU, virtual memory, and unfragmented disk space.

Norton Navigator, a companion product for Norton Utilities, is an enhancement of the Windows 95 Explorer. Navigator lets you set up "multiple virtual desktops," different looks and configurations that you can quickly load and switch between. Navigator also incorporates tools for preparing files to move to other systems, such as a way to create self-extracting archives and a uuencode/uudecode utility for sending binary files across the Internet.

Quarterdeck's QEMM memory manager, in the old days of DOS, made parts of the upper memory area available to store drivers. Today, it enables Windows 95 to compress data in memory and make it appear as though the system has more memory available.

For diagnostics, Cybermedia's First Aid 2.0 will examine error messages and other system problems and recommend solutions. Mastersoft's Viewer95 supplements Win 95's existing image viewer by supporting Hypertext Markup Language (HTML) images.

Evolving with the OS

While new versions of utilities may often do the same tasks as their older versions, the new ones don't always work the same. Like the OS itself, they change, offering new capabilities and finding better ways of doing old things. For example, Norton SysInfo originally obtained much of its system-configuration data by reading the CMOS memory that maintained the information used to boot the PC and recognize devices such as hard disks. However, CMOS memory is static. Under most circumstances, it cannot automatically recognize and adapt to changes in the system hardware. It's possible that information in CMOS, and therefore the information reported by Norton SysInfo (and other similar utilities), could be incorrect.

But an industry consortium led by Intel is in the process of developing the Desktop Management Interface (DMI), part of whose role is to dynamically determine the system configuration and status, prepare and execute queries of system resources, and perform fault diagnosis. The PC updates the DMI data whenever the configuration changes, so the information provided to network administrators is always up to date.

Future iterations of utility software will make use of the DMI, and other new capabilities of the PC architecture, to read system information. This will ensure that system information is accurate and up to date: accomplishing the same task as before, but in a different and better way.

Agents of the Future

Microsoft's introduction of the System Agent—and its OS hook—portends a new way of thinking about utilities. Developers can adapt an agent to many tasks besides detecting system idle time and launching other utilities. The system agent of the future might be able to detect unstable conditions and warn the user before a failure occurs, or perform housekeeping chores such as backing up files.

A preview of what you can use a system agent for comes from Charles River Analytics (Cambridge, Massachusetts), the developer of Open Sesame. Open Sesame uses system agents, along with a neural network, to "learn" your normal pattern of actions and then assist in performing common activities. For example, if you routinely open a word processor and resize and reposition the document window in the same way every time, Open Sesame will "observe" this behavior and ask if you want it done automatically. Open Sesame has been so useful as a Macintosh utility that Apple is incorporating some of its functions into its next-generation Copland operating system.

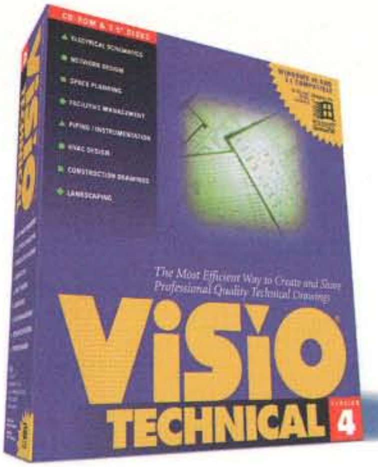
An agent itself may be an OS utility. Agents can be used to perform many tasks behind the scenes, either by themselves or in conjunction with other utilities. An agent can change the scheduling algorithm to allocate CPU time between running processes or change the priority of the processes. These types of agents need artificial intelligence, such as the neural network used by Open Sesame, to detect complex patterns of operation and behavior and then use that information to tune the OS.

A Future for Utilities?

The relationship between an OS and a utility is symbiotic. The OS provides the "host," without which the utility cannot survive. The utility, on the other hand, can actually help the OS perform better or behave more reliably. If a utility is incorporated into the OS, it can improve its overall capability, just like beneficial microorganisms in the human body.

A smart developer will make sure a utility evolves into something completely different, yet just as useful, as its predecessor, and begin the symbiotic process all over again. ■

Peter D. Varhol is chair of the graduate computer science department at Rivier College in New Hampshire. He can be reached at pvarhol@mighty.riv.edu.



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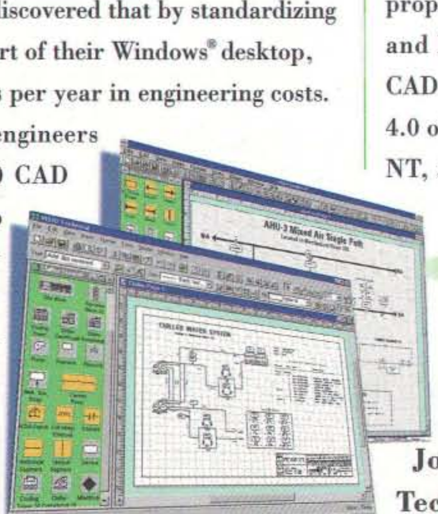

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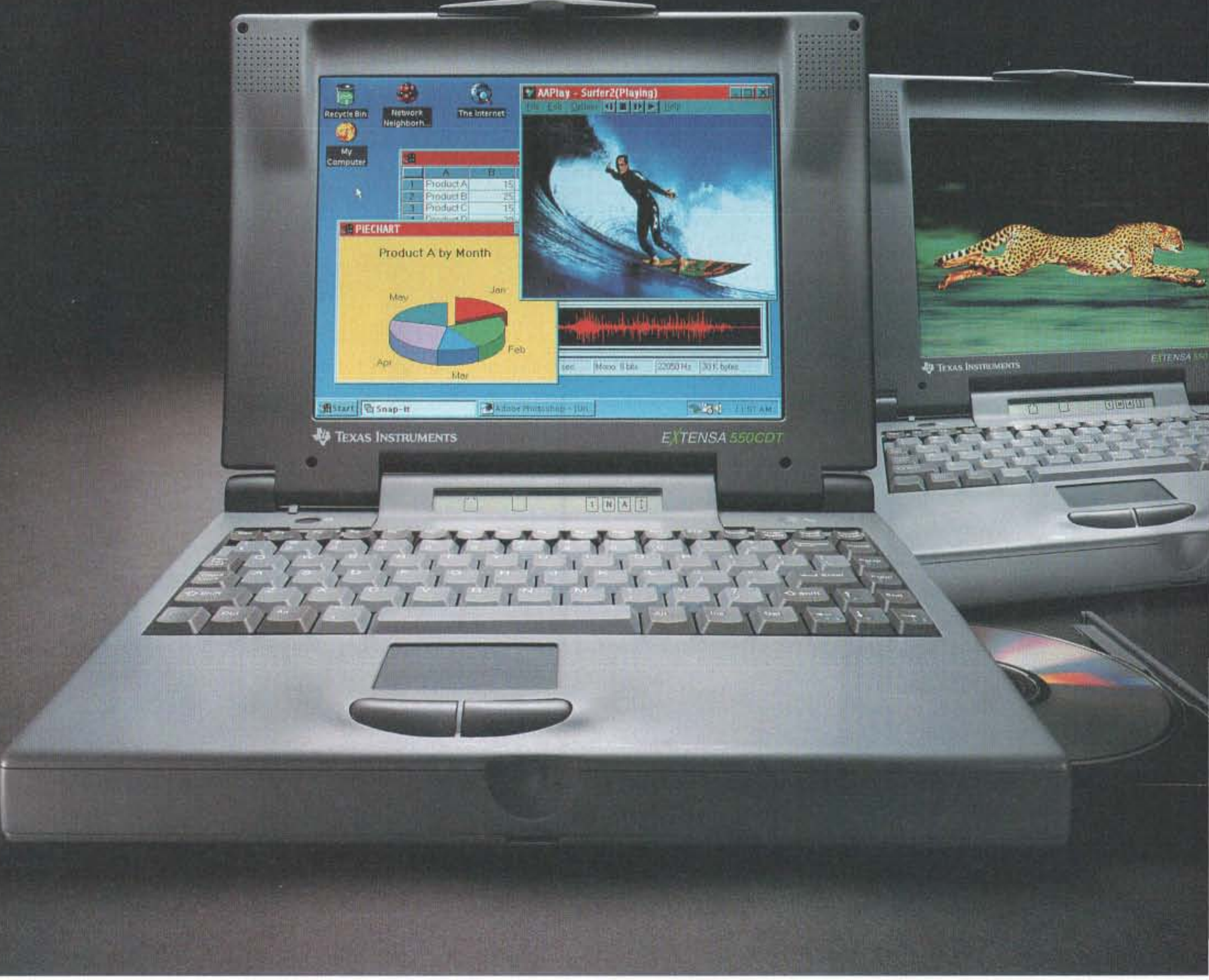

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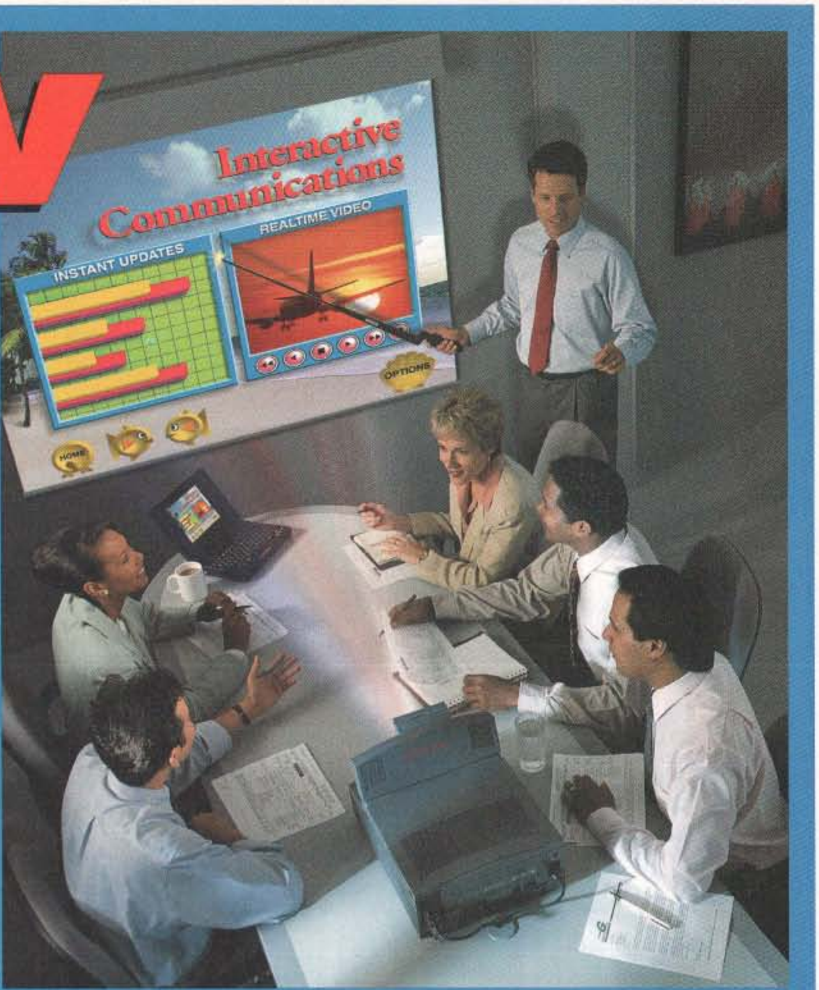

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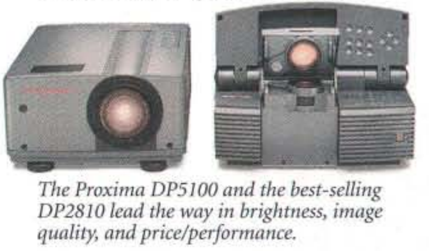

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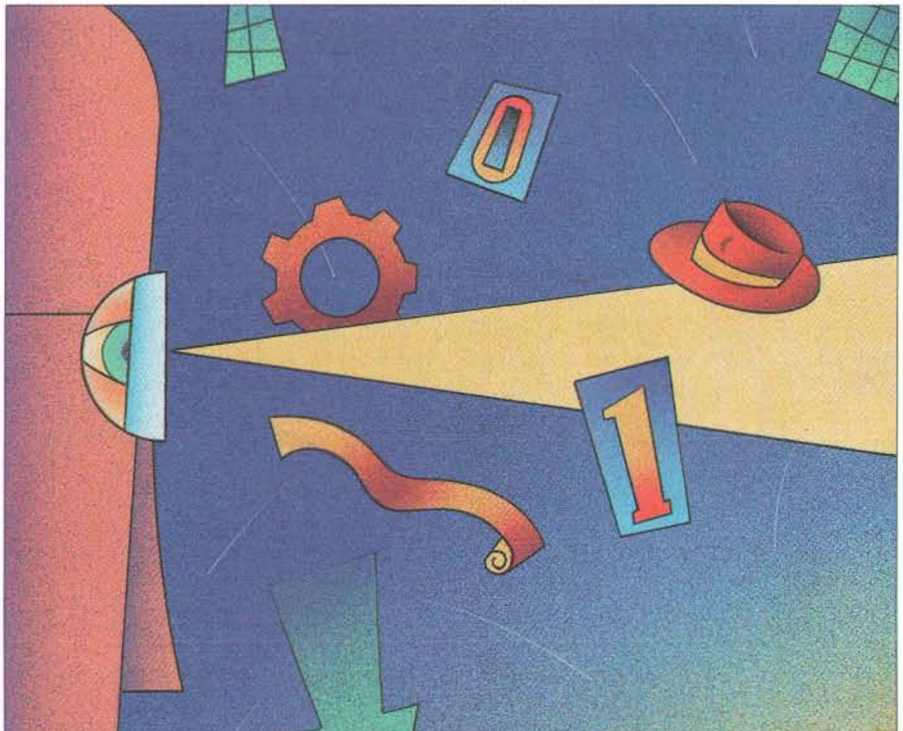
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The OS market, being the cutthroat and competitive beast it is, gives vendors few opportunities to experiment with new approaches to distributed computing. However, a few vendors—AT&T and Sun Microsystems, for example—and some research universities are taking a shot at developing distributed OSes. They claim these OSes will do a better job of exploiting today's ubiquitous networking infrastructures and the processing power distributed throughout organizations.

Until recently, most of the work in this area centered around OSes that required large amounts of memory and suffered from kludgy network connections. (In other words, they were variations of Unix.) Additionally, many distributed OSes (especially those for embedded systems) were proprietary and lacked ways for third-party developers to easily access the services of the OS.

Now, however, a handful of researchers are tinkering with ways to overcome some of the difficulties involved in making OSes work in distributed environments. Companies and universities are attacking the present problems in several ways. For example, some are focusing on improving network connections, others are developing OSes capable of supporting add-on modules, and still others are looking at ways to shrink the OS microkernel.

Plan 9 = Unix++

One effort to develop a distributed OS is being carried out by the Computing Science Research Center of AT&T Bell Laboratories (Murray Hill, NJ). The group is trying to build on a previously successful project—Unix, which it developed a quarter of a century ago.

At that time, Unix was at the forefront of several emerging ideas: applications portability, desktop processing, and multiprocessor design. As Unix weaved its way onto corporate desktops during the 1980s, researchers asked the question: "If we could develop Unix now, what would we do differently?"

While Unix possessed many strengths, one weak area was its networking capabilities. "Connecting different Unix computers on a network requires a great deal of administrative overhead," notes Robert Pike, a member of the technical staff at AT&T Bell Laboratories.

Thus, in 1987, the Computing Science Research Center began work on a new OS dubbed Plan 9. The name is in honor of Ed Wood's campy science fiction thriller *Plan 9 from Outer Space*, which is considered by many to be the worst movie of all time.

Plan 9 is a distributed OS comprised of three components. They are a client part that runs on terminals residing on a user's desk, file servers that store data, and other servers (sometimes called applications servers) that provide faster CPUs (which are on the user's desktop), user authentication, and network gateways.

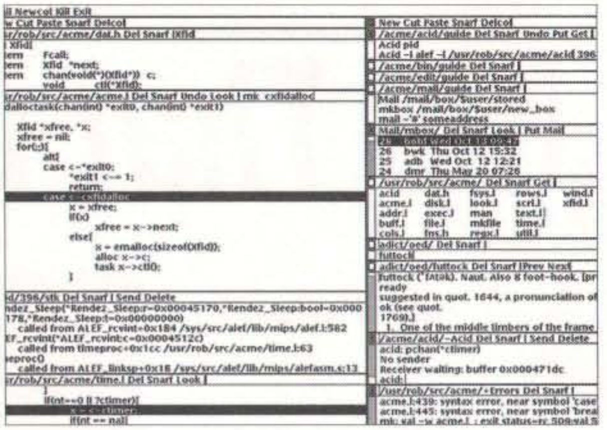
The components can be connected over a wide variety of LANs and WANs—including Ethernet, custom-built fiber networks, and dial-up modem connections—as well as over ISDN. Typically, a user interacts with applications running on either a terminal or a CPU server, and the applications pull their data from the file servers (see the figure "Plan 9's Down-to-Earth Architecture" on page 118).

Plan 9 exploits three general technical concepts. First, all system objects present themselves as named files that are manipulated by read/write operations. Second, all such files may reside either locally or on another device. Third, the file system namespace (i.e., the set of objects visible to a program) is dynamically adjustable for each program running on a particular machine.

The first two concepts, in the opinion of Plan 9's developers, were ideas foreshadowed in Unix. The third concept, however, allows a new approach to distributed computing. The construction of an application is not dependent on where the application will run or on what machine it will run on. Thus, Plan 9 allows for a modular design of applications.

Because applications and data may reside in many locations, security is a key component of Plan 9. It uses an authentication scheme similar to Kerberos, where passwords are never sent over networks. Instead, it uses encrypted tickets issued from an authentication server. Plan 9 has additional security features. For instance, applications never run on the file servers (the place data is stored under Plan 9). This makes data stored on those servers safe from security threats such as computer viruses.

Another strength of Plan 9 is that its flexibility eases administration. "Plan 9 users can access information stored on computers with different microprocessors as if the data were stored on their own system," says Pike.



```
il Newcol Kill Exit
w Cut Paste Snarf Delcol
sr/rob/src/acme/dat.h Del Snarf |Xfid
 Xfid|
lem     Fcall;
lem     Xfid  *next;
lem     chan(void(*)(Xfid*))  c;
        void        ctl(*Xfid);
sr/rob/src/acme/acme.l Del Snarf Undo Look | mk  cxfidalloc
dalloctask(chan(int) *exit0, chan(int) *exit1)

   Xfid *xfree, *x;
   xfree = nil;
   for(;;){
        alt{
        case <-*exit0:
              *exit1 <-= 1;
              return;
        case <-cxfidalloc:
              x = xfree;
              if(x)
                    xfree = x->next;
              else{
                    x = emalloc(sizeof(Xfid));
                    alloc x->c;
                    task x->ctl();
              }
d/396/stk Del Snarf | Send Delete
ndez_Sleep(*Rendez_Sleep:r=0x00045170,*Rendez_Sleep:bool=0x000
178,*Rendez_Sleep:t=0x00000000)
   called from ALEF_rcvint+0x184 /sys/src/alef/lib/mips/alef.l:582
EF_rcvint(*ALEF_rcvint:c=0x0004512c)
   called from timeproc+0x1cc /usr/rob/src/acme/time.l:63
eproc()
   called from ALEF_linksp+0x18 /sys/src/alef/lib/mips/alefasm.s:13
sr/rob/src/acme/time.l Del Snarf Look |
        }
        if(nt==0 || ?ctimer){
              x = <-ctimer;
              if(nt == nal)
```

```
New Cut Paste Snarf Delcol
/acme/acid/guide Del Snarf Undo Put Get |
Acid pid
Acid -l alef -l /usr/rob/src/acme/acid 396
/acme/bin/guide Del Snarf |
/acme/edit/guide Del Snarf |
/acme/mail/guide Del Snarf |
Mail /mail/box/$user/stored
mkbox /mail/box/$user/new_box
mail -'#' someaddress
Mail/mbox/ Del Snarf Look | Put Mail
27   bobf Wed Oct 13 09:47
26   bwk  Thu Oct 12 15:32
25   adb  Wed Oct  12 12:21
24   dmr  Thu May 20 07:26
/usr/rob/src/acme/ Del Snarf Get |
acid      dat.h     fsys.l    rows.l    wind.l
acme.l    disk.l    look.l    scrl.l    xfid.l
addr.l    exec.l    man       text.l
buff.l    file.l    mkfile    time.l
cols.l    fns.h     regx.l    util.l
adict/oed/ Del Snarf |
futtock
adict/oed/futtock Del Snarf |Prev Next
futtock ('fʌtək). Naut. Also 8 foot-hook. [pr
ready
suggested in quot. 1644, a pronunciation of
ok (see quot.
1769).]
  1. One of the middle timbers of the frame
/acme/acid/-Acid Del Snarf | Send Delete
acid: pchan(*ctimer)
No sender
Receiver waiting: buffer 0x000471dc
acid: |
/usr/rob/src/acme/+Errors Del Snarf |
acme.l:439: syntax error, near symbol 'case
acme.l:445: syntax error, near symbol 'brea
mk: xal -w acme.l : exit status=rc 509:xal S
```

Part of a Plan 9 screen using the Acme user interface (UI). The left column holds a few source files, and a debugger window displaying a stack trace and a third source file. The right column contains some guide files, a mailbox presented by Acme's mail program, the columnar display of files in Acme's own source directory, a few windows from the OED browser, a debugger window, and an error window showing diagnostics from a compilation.

AT&T Bell Laboratories has ported Plan 9 to several types of CPUs, including Intel's x86 (including the Pentium), Motorola's 680x0, Sun's SPARC, and Mips Technologies' microprocessors. In addition, the Computing Science Research Center has developed compilers and debuggers for the new OS.

In July, AT&T announced that Plan 9 was available for educational and research use. The product with source code sells for $350; a kit with only the manuals is available for $125. The company said 200 universities are working with Plan 9, and Pike expects them to develop new applications and programming tools.

The Plan 9 Network at York

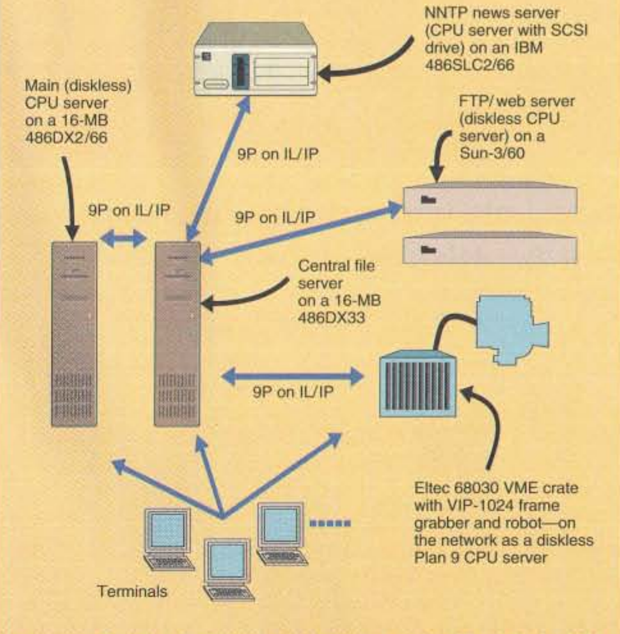

NNTP news server
(CPU server with SCSI drive) on an IBM 486SLC2/66
Main (diskless) CPU server on a 16-MB 486DX2/66
FTP/web server (diskless CPU server) on a Sun-3/60
9P on IL/IP
9P on IL/IP
9P on IL/IP
Central file server on a 16-MB 486DX33
9P on IL/IP
Eltec 68030 VME crate with VIP-1024 frame grabber and robot—on the network as a diskless Plan 9 CPU server
Terminals

Diagram of the Plan 9 (9P) network at the University of York (York, U.K.). Plan 9 terminals include diskless 486s, 68020s and SparcStations, all with bit-map graphics displays. All run the same software from the shared file server and use the faster CPU server for compilations.

Spring Is in the Air

Also focusing on Unix's limitations, SunSoft (Mountain View, CA) began to work on Spring, its next-generation object-oriented OS, in the early part of 1989 (see "Springtime at Sun," September BYTE). Jim Mitchell, a Sun fellow and leader of the Spring R&D team, said the project team established three goals for the OS. First, it had to be easy to evolve and extend. Second, it had to work well on networks. Third, it had to include strong security features.

The company assigned a team of its top 15 programmers to reach those goals. In 1991, the team delivered a prototype of Spring that featured a distributed-directory service, fast interprocessor communication, security services, and a new interface definition language (IDL). The IDL bound its objects at run time, outside the microkernel. This improves the OS's performance by 50 percent, according to SunSoft.

The company has taken a multifaceted approach for spreading the Spring doctrine. SunSoft convinced the Object Management Group (OMG), a Framingham, Massachusetts, consortium, to incorporate Spring's directory service, IDL, and security features in the Common Object Request Broker Architecture (CORBA) 2.0 specifications.

KEY FEATURES OF SPRING

- **Object-oriented to the core.**
- **System designed with security, symmetrical multiprocessing, and distributed-directory services in mind.**
- **One key component, the interface definition language, has already been adopted by and incorporated into the Object Management Group's object-broker standard.**

In March, SunSoft offered Spring to universities and commercial research institutions. It sells the Spring Research Distribution technology on a CD, which

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includes software, documentation, and instructional materials. Universities can purchase the package for $75; corporate research groups pay $750.

In addition, SunSoft plans to incorporate Spring into its commercial products. Mitchell says Spring will be the foundation for the company's Distributed Objects Everywhere (DOE) architecture. SunSoft is also incorporating Spring components into Solaris. The company began beta-testing these capabilities during the summer, and it expects to deliver production wares over the next two years.

OPERATING-SYSTEM RESEARCH: DIM OR BRIGHT FUTURE?

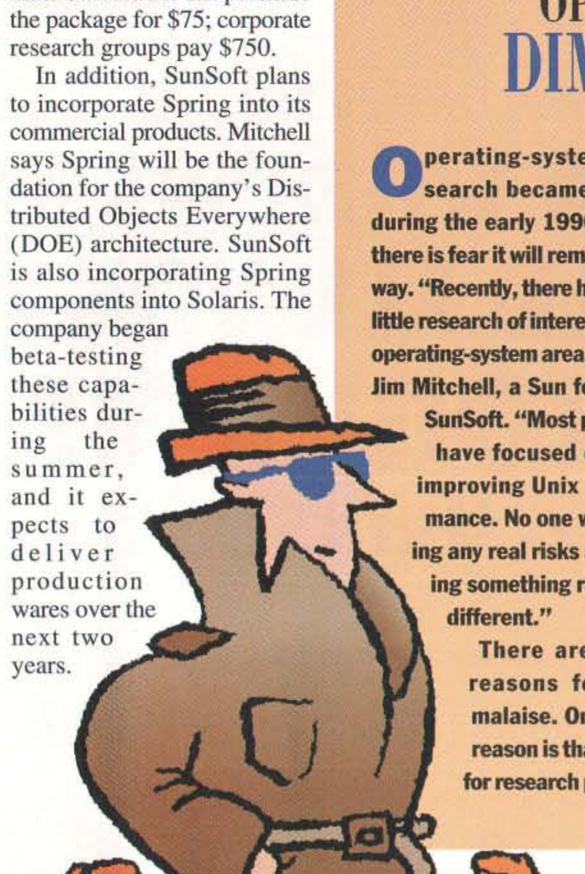
Operating-system research became passé during the early 1990s, and there is fear it will remain that way. "Recently, there has been little research of interest in the operating-system area," notes Jim Mitchell, a Sun fellow at SunSoft. "Most projects have focused only on improving Unix performance. No one was taking any real risks and trying something radically different."

There are many reasons for this malaise. One main reason is that funds for research projects are limited. The two main suppliers, ARPA and the National Science Foundation, have seen their budgets cut as elected officials tighten government spending.

The cuts come just when the competition for R&D dollars has greatly increased. New technologies, GUIs, multimedia applications, networking, and videoconferencing are all vying for limited funding with operating-system projects.

Despite the problem, there is hope. Frans Kaashoek, a professor of computer science at MIT, said researchers focused on filling holes in microkernel technology for several years because the technology was new and limited. A few years ago, researchers realized that they had pushed that technology as far as they could.

Therefore, a handful of projects focusing on new technology have sprouted during the past two years. "Several projects represent the beginning of the next wave of operating-system research," Kaashoek said. "I am confident they will result in design breakthroughs and there will be plenty of areas of interesting research in a couple of years."



Other Efforts Worth Watching

In addition to AT&T and SunSoft, QNX Software has developed an OS called QNX. It overcomes some of the problems with distributed OSes. QNX, which was developed for process-control and embedded-OS applications, is a 32-bit, Posix-compliant, real-time, message-passing microkernel OS for Intel x86 machines. Its core is only 8 KB in size. It supports four functions: process scheduling, interrupt dispatch, interprocessor communication, and network communication.

Outside the commercial world, several notable distributed-OS efforts are now taking place in the academic community. For instance, projects to develop distributed OSes are under way at four universities: MIT, the University of Washington, the University of Arizona, and the University of Utah. The projects are all trying to improve OS performance. All four groups are focusing on different ways to reach that goal.

MIT began work on its distributed OS, called Exokernel, in the fall of 1993. Frans Kaashoek, a professor of computer science, said the project is trying to push OS functions into the user space.

The base OS does not include page-table management, a file system, interprocessor communication, or process management. Instead, it offers only a set of barebone features. As a result, it should operate faster than systems now available. Initial tests indicate that Exokernel works 10 to 100 times faster than Digital Equipment's Ultrix.

In addition to faster processing speeds, the new design offers programmers more flexibility, according to Kaashoek. Currently, OSes offer all applications one set of services. Yet, there are different requirements for different functions in a distributed operating environment. For example, a file system needs different buffering and disk management features than a database management system.

continued

KEY FEATURES OF PLAN 9

- **Small size (a single self-booting disk can hold the kernel, a window system, an editor, and a basic Ethernet/Internet interface).**
- **Modular approach that includes a client, CPU server, and file-server components.**
- **Runs on many CPUs, including Intel's x86 (including Pentiums), Motorola's 680x0, Sun Microsystems' SPARC, and Mips Technologies' Mips microprocessors.**
- **Strong security features, including an authentication scheme that's similar to Kerberos.**

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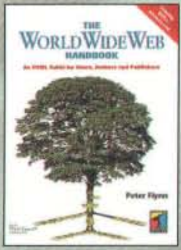

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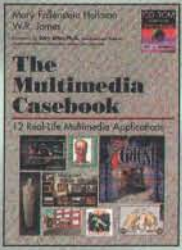

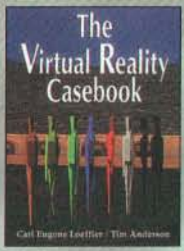
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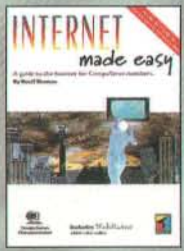

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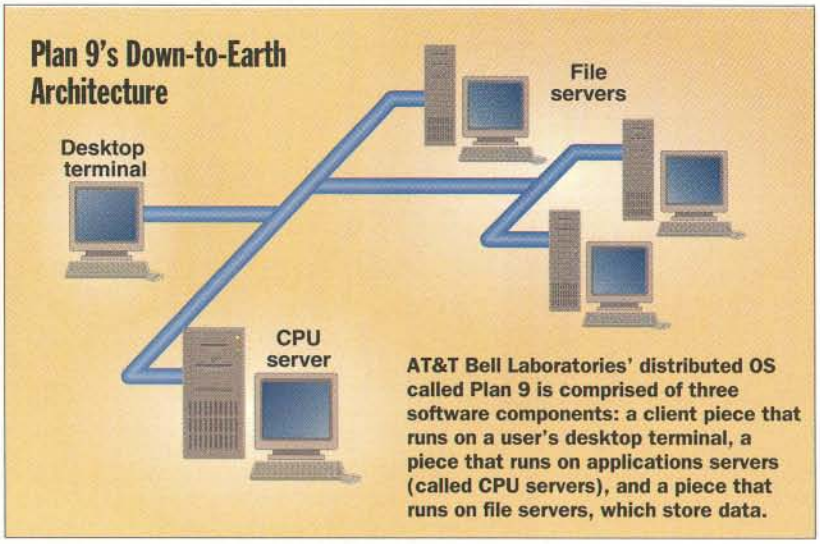
Kaashoek says Exokernel enables programmers to address these differences by letting them build subsystems for different types of applications.


Plan 9's Down-to-Earth Architecture

AT&T Bell Laboratories' distributed OS called Plan 9 is comprised of three software components: a client piece that runs on a user's desktop terminal, a piece that runs on applications servers (called CPU servers), and a piece that runs on file servers, which store data.

The University of Washington is taking a similar approach with its Spin project, which began in early 1994. Brian Bershad, an assistant professor of computer science, said current OSes have to be trimmed. "Just to load Windows NT requires at least 16 MB of storage," he explains. "And various OS functions take up processing power even if they are not used." For instance, 30 percent of current OS overhead comes from memory management and networking functions.

Spin replaces functions now found in the user address space with downloadable OS extensions. This modification lets programmers extend the microkernel and control OS functions.

The new design could produce an interesting side effect. Currently, OS designers determine all system functions. "We need to loosen the grasp OS vendors have on determining their systems' APIs," Bershad said. With Spin's approach, the OS becomes a foundation that third parties can build on.

PORTS

Plan 9 has been ported to these compilers:

- Motorola MC68020
- Mips
- SPARC
- Intel 386
- Intel 960
- AT&T 3210
- SGI Power Series
- SGI Indigo
- SGI Challenge M
- SparcStation
- IBM PC

...OSes:

- Gnot
- Nextstation
- Mips Magnum

...and file servers:

- SGI
- Mips 6280
- Mips Magnum
- SparcStation
- IBM PC

The University of Arizona has tinkered with OSes since the late 1980s. "New networking techniques that promised to support speeds of 500 Mbps were emerging, so new OSes were needed to keep pace," notes Larry Petersen, a fellow in the computer science department.

The university has been working on the Scout project. "With client/server applications, a process could be completed in one of many different locations," Petersen says. "Current OSes do not easily enable this to take place."

Thus, the university's new OS relies on something called paths (i.e., considered roads that show how functions are completed) rather than processes, which focus on what an OS does. The university is developing a version of Scout for Digital's Alpha computers.

Rounding out the academic efforts is the University of Utah's project, dubbed Flux, to enhance the Mach OS. One result of Flux was the development of a new IDL called Flexible Interface Definition (FLICK) and a series of shared libraries. "Our goal was to address inefficiencies that stemmed from Mach's underlying language," explains Jay LePreau, who is a professor in the university's computer science department.

The new OS is designed to run on Intel and Hewlett-Packard PA-RISC microprocessors. In addition, the OS's distributed shared-memory system is available on five architectures—Digital's Alpha, HP's PA-RISC, Mips, Motorola 68000, and Sun's SPARC—and five OSes, including Digital's OSF/1, HP's HP-UX, Silicon Graphic's IRIX, Sun's SunOS, and Unix 4.3 BSD.

SuperNOS = NetWare + UnixWare

The university research projects may compete with corporate development that's under way at Novell (Provo, UT). After purchasing Unix Systems Laboratories (USL) at the end of 1992, Novell found itself with two OSes: NetWare and UnixWare. The company's long-term goal has been to consolidate them into a single system, which has been dubbed SuperNOS.

Toby Corey, vice president of marketing for Novell's Operating Systems Division, says the company plans to meld the strengths of each OS. It will blend NetWare's fast file and print services with UnixWare's support for symmetrical multiprocessing, its ability to scale well, and its support for large, complex servers.

Novell has been talking about the SuperNOS concept for a while. However, a real OS that combines the strengths of NetWare and UnixWare is still a long way from delivery. Corey says the system is being designed for machines that support Intel's P7 64-bit microprocessors, which should arrive in late 1997 or early 1998.

Time Will Tell

Such long lead times are typical with these projects. The R&D work for distributed OSes is in a nascent stage, and, for the most part, there is no clear path from the laboratories to the desktop.

Researchers are not sure if their work will make its way into the mainstream. For instance, AT&T has downplayed comparisons between Plan 9 and Unix. It does not view the new OS as a Unix replacement. "Plan 9 was designed to solve specific problems experienced by users working with large, complex, multiprocessor systems," Pike says. "Consequently, there has been a great deal of interest in it among members of the university community. We are not sure if it will evolve into anything but a niche solution for a specific type of user."

To gauge the impact of today's projects, one might need to take a look back. "Research work on microkernel technology began in the early 1980s, winners emerged in the middle of the decade, and users began to realize the benefits of this work as the decade closed," notes Bershad at the University of Washington. "I see no reason why work from current projects should emerge any differently." ■

Paul Korzeniowski is a freelance writer based in Malden, Massachusetts. You can reach him on the Internet at 6841944@mcimail.com or on BIX c/o "editors."

Sincere OS Flattery

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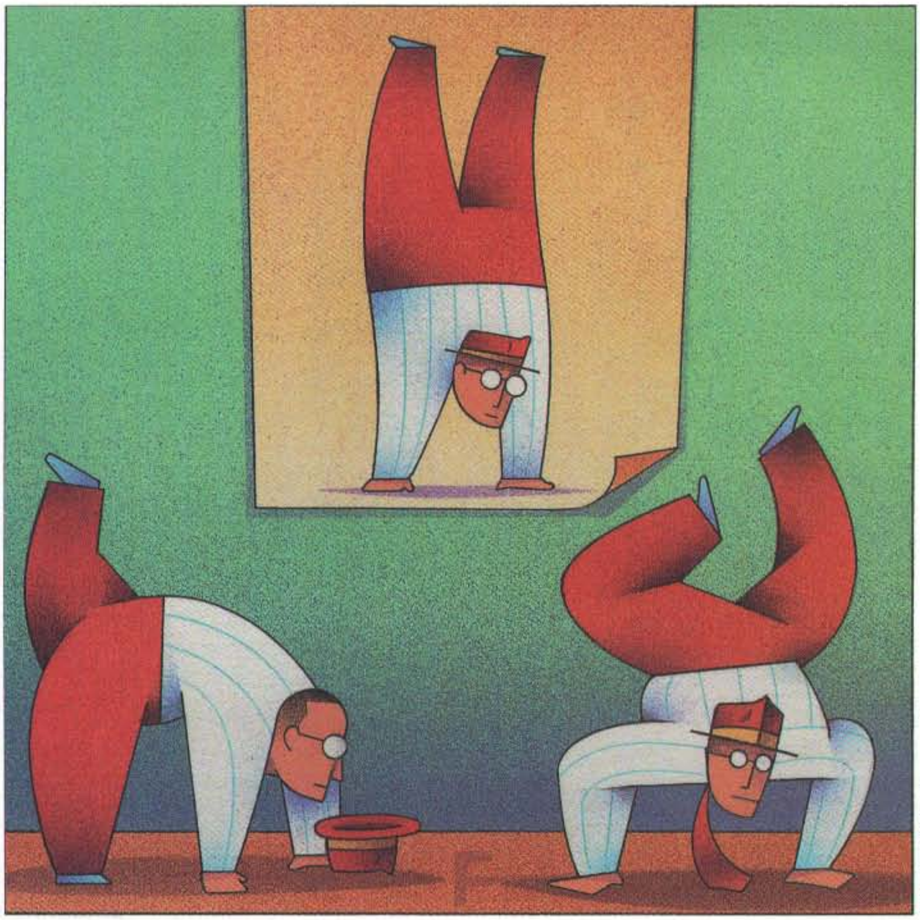

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Emulators help you run existing applications on a wider variety of OSes

You do your engineering under Unix, you do graphics on a Mac, and you use a Windows-based word processor. Do you need three computers? Maybe not. Maybe you just need a good emulator.

Emulating an OS goes beyond recognizing one CPU's instructions and translating them to another CPU's architecture. Emulators need to provide an environment in which specific hardware devices (e.g., video adapters and parallel ports) appear to be present. They also need to compensate for the differences between the native file system and the emulated file system, as well as provide networking support, file sharing, and record locking.

Despite these challenges, several companies offer OS-emulation products, including Insignia Solutions (SoftPC and SoftWindows), Locus Computing (DOS Merge), and SunSelect (Wabi). In Windows NT, Microsoft's emulation of 16-bit Windows is a version of SoftWindows. IBM is the hands-down winner, though. Over the years, IBM has emulated many CPUs and OSes, ranging from second-generation 1401 and 7074 I/O Control Systems (IOCSes) hosted on mainframes (i.e., 370 architecture) to IBM PC-DOS hosted on an RS/6000.

Some of these emulators, such as the DOS-on-RS/6000 product (called PC Simulator), are no longer on the market. IBM's two most popular emulators run DOS and Windows programs in the OS/2 environment. The programs run directly on the Intel CPU in virtual-8086 mode, yet they can access files on a High Performance File System (HPFS) drive and perform port-level I/O through OS/2's serial, parallel, DMA, and other virtual device drivers (VDDs).

Differences Exist

Emulators take different approaches. The one chosen depends on whether the target CPU can execute the emulated OS's instructions and whether the emulator developers have access to the OS's source code.

Insignia Solutions' SoftWindows can run x86-based Windows programs on RISC or 680x0 CPUs, hosted by either Unix or Macintosh System 7. Insignia Solutions licenses Windows source code from Microsoft. DOS Merge, from Locus, runs DOS and Windows programs on Unix-based Intel CPUs (e.g., running SCO Unix). Like Insignia Solutions, Locus has licensed Windows source code from Microsoft. SunSelect's Windows Application Binary Interface (Wabi) can run some but not all Windows programs on Unix-based non-Intel machines. Instead of licensing Windows source code, SunSelect chose to use the published Windows API to engineer its emulator.

PC video hardware presents special problems for the emulator. To run Windows programs, most emulators provide Windows video drivers that act as a liaison between the host (native) video system and Windows. Often, the emulator offers both a full-screen and a windowed (seamless) video driver.

Under Unix, for example, a Windows application can appear in its own X Window System window. Similarly, OS/2 can show

Elements of Emulation

- **VGA or SVGA video adapter**
- **serial (COM) ports**
- **parallel ports**
- **Ethernet or Token Ring network adapter**
- **file system (directories, filenames, and file contents)**
- **floppy drive**
- **extended, expanded, and conventional memory**
- **ROM BIOS**
- **CMOS configuration data**

An OS-emulation product must not only translate CPU instructions but also establish an environment in which these hardware elements appear to b present and functioning.

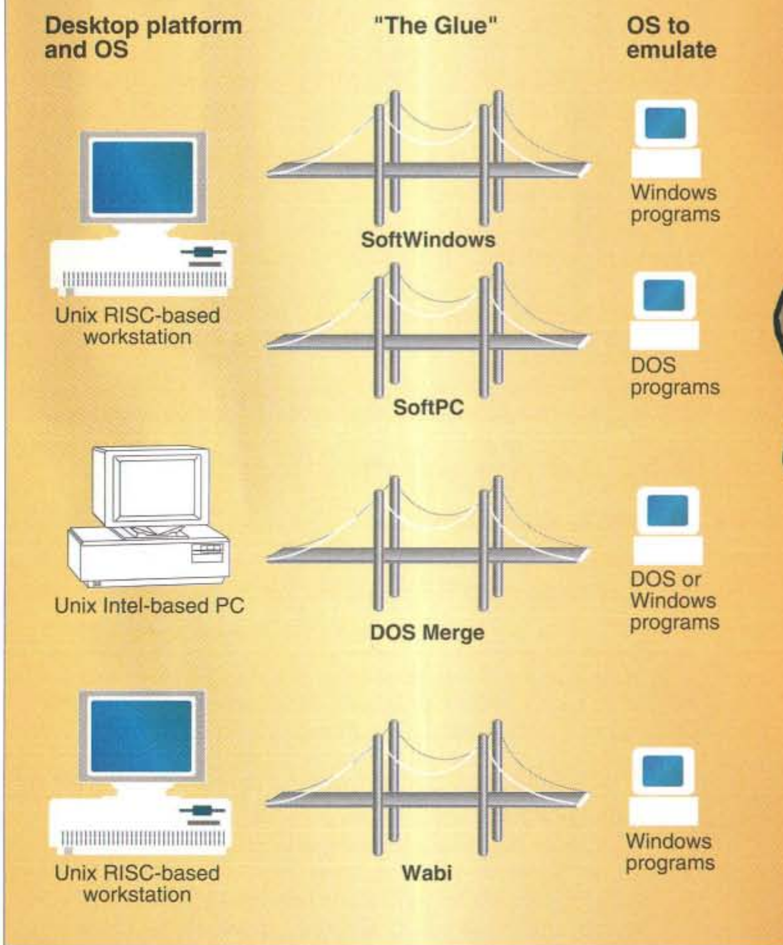
a Windows program running on the OS/2 desktop. On Macs, SoftWindows contains a Windows video driver that translates screen updates into QuickDraw calls. So complete is the video support that emulators on Unix, OS/2, and Mac System 7 can properly process an application's changes to the Windows color palette as well as changes to the mouse-cursor shape. In the latter case, the emulator changes the mouse cursor to the appropriate shape depending on whether it's in the emulated Windows screen region.

The emulator might allocate a portion of the host OS's file system for use by the emulated OS, or it might go a step further to translate the emulated OS's file information into host file information. Translated file information lets both the host OS and the emulated OS share the same files and directories (or Mac folders). Because products such as Microsoft Word and WordPerfect use the same file layout on the Mac and the PC (depending on the version of the product), the result is transparent file sharing between different operating environments.

Emulators usually allow cut, copy, and paste operations between the host OS and the emulated OS. In the Win-OS/2 environment, IBM uses a technique called *deferred rendering* to speed up Clipboard access. Win-OS/2 renders the Clipboard in an application's desired format (e.g., CF_TEXT) when the application asks for the data. OS/2 thus avoids having to render the data in all possible formats at the time the data is placed on the Clipboard.

The Insignia Solutions products interleave Clipboard translations with window redrawing. When you switch from one window to another, SoftWindows uses a small amount of time to process the Clipboard data. SoftWindows implements Clipboard sharing with a pair of programs called Smart Copy, one a Windows application and one a native-OS application.

Bridging the Gap



Emulation programs let DOS and Windows programs run on many platforms and OSes.

You can configure printer emulation in a variety of ways. In Win-OS/2, you can print to a printer port named LPTx.OS2, a serial COM port, or a file. In SoftWindows running in a Unix environment, you can choose to send LPTx data to a Unix file, to `/dev/lp`, or through a pipe to the Unix `lpr` utility. On the Mac, SoftWindows simply sends print data to the System 7 print manager.

Speed It Up!

When you leave the world of x86, things get really complicated. RISC and 680x0 CPUs don't understand x86 instructions, of course. The emulator parses each x86 instruction, decodes it to determine its intended effect, and executes RISC or 680x0 instructions to produce the same result an Intel CPU would have produced. Along the way, the emulator faithfully imitates the registers, flags, internal arithmetic, and logic states of the Intel CPU.

A GUI application, especially one that's highly interactive, spends much of its time inside OS service routines. Emulators take advantage of the application's loitering inside the OS to make the application run faster. For example, SoftWindows contains precompiled ("static") functions that

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Circle 293 on Inquiry Card (RESELLERS: 294).

implement often-used Windows API and DOS functions. The emulator can quickly execute some native code that achieves the same result as if it had examined and translated each system instruction in the API library. Also, SoftWindows contains an optimizing compiler that dynamically evaluates the code it's emulating, looking for ways to speed up program execution.

Wabi uses the workstation's native X display protocols to manage the appearance of Windows applications on Unix workstations. Wabi translates DOS I/O into Unix I/O, and it similarly manages memory allocations and other resources.

Using technology from Praxsys Technologies, Wabi decodes and imitates individual x86 instructions that are not inside a Windows API or DOS function call. Within such a system call, Wabi switches to native mode to perform the DOS or Windows function in terms of equivalent X or Unix system calls.

SunSelect engineered Wabi not by acquiring a Windows source code license, but rather by establishing an environment in which each published, well-known Windows API call or DOS function call is available as a Wabi library routine. SunSelect publishes a list of 24 applications that it guarantees Wabi will run. Wabi can't run all Windows programs, especially those that have intimate knowledge of the Windows environment.

Windows applications running under Wabi have the look and feel of an X-based Unix GUI such as Motif or OpenLook, rather than that of Windows. And instead of running the entire Windows desktop environment within a single window, as SoftWindows does, Wabi opens a new window on the Unix desktop for each Windows-based application.

Wabi runs Windows programs fairly quickly because it contains precompiled equivalents for each Windows API function. Wabi doesn't have to translate instructions in Windows system files (e.g., USER.EXE and GDI.EXE).

The Same CPU Issues

Just as OS/2 gives DOS and Windows programs partial control of the CPU yet retains sufficient ownership to virtualize I/O ports and the file system, SCO Unix uses DOS Merge to run DOS and Windows programs directly on the Intel CPU. DOS Merge runs DOS and Windows programs full-screen or within an X Window System 11 window at VGA or higher resolution. DOS Merge consists of three levels of emulation: DOS, ROM BIOS, and direct-to-hardware screen memory. Besides offering a bridge between DOS and Unix resources, DOS Merge also supports direct exclusive access to hardware devices (e.g., scanners) with no equivalent Unix device driver.

The Mac 6100 can run DOS programs on a 486 coprocessor, without the need to emulate Intel instructions on the RISC CPU. Apple placed a 25-MHz 486SX processor, a Chips & Technologies BIOS, a VGA chip set, and some of its custom ASICs on a 68040 Processor Direct Slot plug-in board. The DOS card can have up to 32 MB of RAM on it, or it can share memory on the Mac's main logic board. At boot-up time, the Mac scans the board for RAM. If none is found, the emulator dedicates a user-configurable amount of RAM on the main logic board to the DOS environment.

Required Support

- **Windows 95**
- **Windows 3.1 and 3.11, and Windows for Workgroups**
- **various versions of DOS**
- **486 and Pentium instruction sets**
- **file compressors, disk defragmenters, and other file system utilities**

The developers of an OS emulator must provide support for a wide range of software, including different versions of the OS itself.

Hardware transceivers in a custom ASIC on the DOS card do the byte swapping required by the different processor architectures (Intel CPUs store integers low byte first). Memory-controller hardware keeps the address spaces of the two environments separate. The DOS-emulation environment maps the Mac's floppy drive as DOS drive A. Apple even provides an MSCDEX extension; on a Mac with a built-in CD-ROM drive, DOS programs can access CD-ROMs.

Product Information

DOS Merge.....bundled with many OSes
Locus Computing Corp.
Inglewood, CA
(800) 955-6287
(310) 670-6500
fax: (310) 670-2980
Circle 1228 on Inquiry Card.

SoftPC.......$249
SoftWindows......$499
Insignia Solutions, Inc.
Mountain View, CA
(800) 848-7677
(415) 335-7100
fax: (415) 335-7105
Circle 1229 on Inquiry Card.

Wabi......$225
SunSoft, Inc.
Mountain View, CA
(800) 786-7638
(415) 960-3200
fax: (415) 336-2473
Circle 1230 on Inquiry Card.

The DOS coprocessor board operates independently of the Mac's CPU, which means that DOS/Windows applications can run concurrently with the Mac OS. You hot-key between the two environments. And selecting a printer via the Mac Chooser selects the same printer for the DOS environment. The emulation software routes DOS print streams to the selected printer. The coprocessor approach has a huge edge over CPU instruction translation—DOS programs run full-speed on the 486 and actually multitask with programs running on the Mac's CPU.

Taking Care of Windows 95

The biggest challenge for emulators isn't running an oddly written device driver or virtualizing an unusual adapter. It's Windows 95. Emulator developers are hard at work exploring the instructions that make up the new version of Windows. Insignia Solutions and Locus are arranging to acquire Windows 95 source code from Microsoft, which will make the job much easier. But even with source code at hand, emulating Windows 95 is a formidable task. A Windows 95 emulator has to manage Win32 API functions, frequent switches between protected and real mode, virtual device driver (VxD)—ring 0—CPU operation, and a minefield of combined 32- and 16-bit memory accesses.

Locus and Insignia Solutions have announced they'll support Windows 95 in future versions of their products. To date, IBM has said only that it will supply an OS/2 library of Win32 functions that OS/2 programs can use (thus easing the chore of porting Win32 programs to OS/2). Rumors abound, however, that IBM may eventually provide a full Windows 95 emulator in OS/2 Warp.

Emulation for Windows 95 will be an important issue for the field of OS emulation. However, Windows 95 is just one of many OSes that users will want supported.

The range of CPUs and OSes that must be supported is growing all the time. Users will increasingly demand that they be able to run existing applications on whatever platform and OS they choose. And, as time goes by, that will only serve to elevate the role of OS emulators in organizations. ■

Barry Nance is a BYTE consulting editor. He is the author of Using OS/2 Warp *(Que, 1994) and* Introduction to Networking *(Que, 1994). You can reach him on the Internet or BIX at barryn@bix.com.*

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- 3 ☐ Reseller/distributor/OEM/integrator/consultant
- 4 ☐ Other (please describe): ______________

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- 6 ☐ IS/MIS/IT Management
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- 10 ☐ Other (please describe): ______________

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- 13 ☐ Mac/OS
- 14 ☐ UNIX (any, including Solaris)
- 15 ☐ Windows
- 16 ☐ Windows/NT
- 17 ☐ NetWare
- 18 ☐ Other (please describe): ______________

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- 25 ☐ PC Telephony

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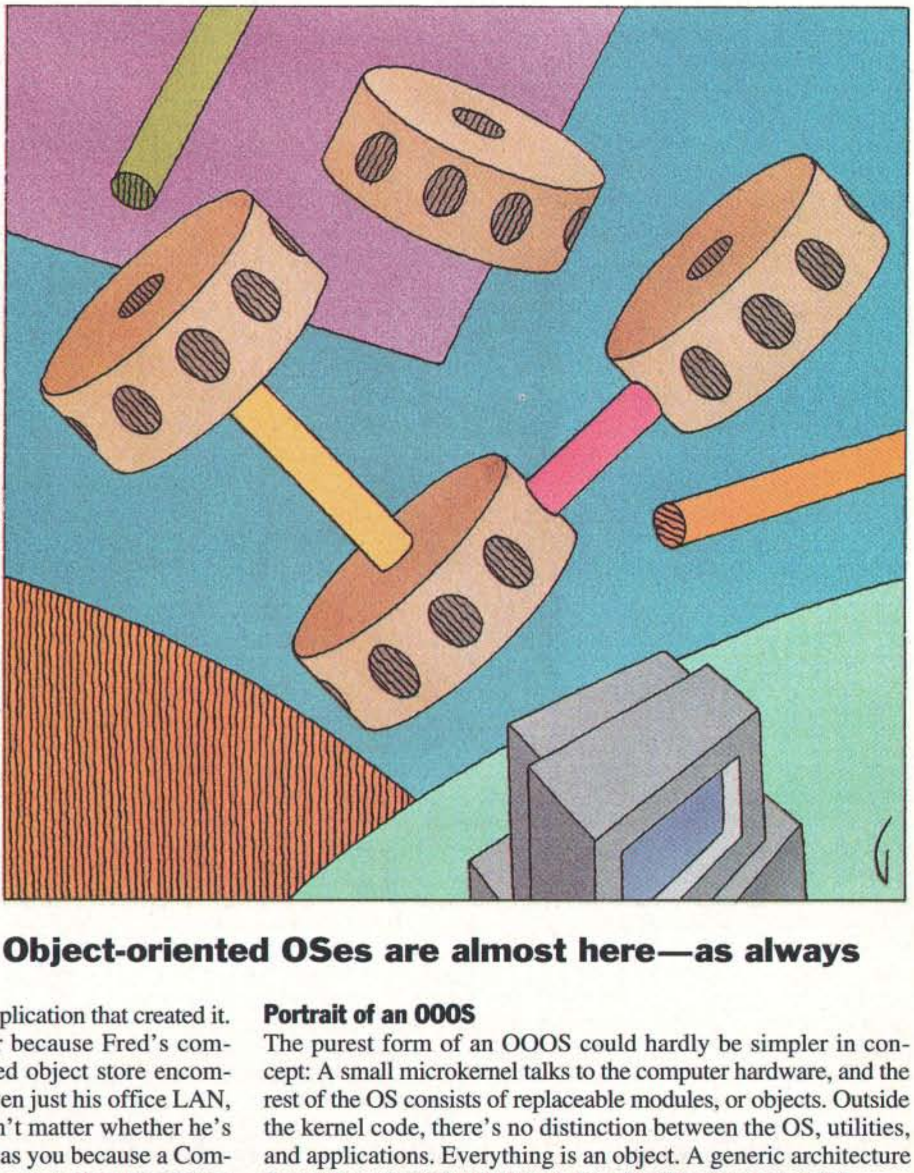
OO Meets OS

Object-oriented OSes are almost here—as always

DICK POUNTAIN



JOSEF GAST © 1995

How hard do you laugh when you hear that "there is an object-oriented OS in your future"? It's not that the words are *necessarily* untrue. Unfortunately, however, OOOSes remain stubbornly stuck in your future, not your present.

Why should you care? How about better integration. Microsoft Office users already take for granted the ability to drag an Excel graph into a Word document. Now picture this: You need a widget diagram for your monthly report. Click on the search button and ask for widgets. Soon the search returns an icon for the report "Widgets in the 1990s" by Fred Smith in the Manchester office. You open it, drag his diagram into your document window, and attach an electronic Post-It note to his report, thanking him for the loan. Computer users now only dream of this seamless, content-addressable data access, but an OOOS is the way there.

Which OOOS aspects are in this fantasy? Well, the reason you could locate that widget diagram is that Fred's report is a compound document—a collection of objects whose multiple attributes are made visible to the search software—rather than a file that is just a named bag of bits and makes sense only to the application that created it.

Your search could reach Manchester because Fred's compound document is stored in a distributed object store encompassing not just his own hard disk, nor even just his office LAN, but the whole company's WAN. It doesn't matter whether he's running the same hardware (or even OS) as you because a Common Object Request Broker Architecture–compliant (CORBA) ORB broadcast your search in a platform-neutral format. You didn't need to explicitly log on to any network or run a communications program because in this *persistent object store*, you access objects by specifying their names or attributes, neither knowing nor caring where they are physically stored.

Finally, you could drag the diagram from his document into yours because both documents conform to the same object-embedding interface. This might be OpenDoc or Microsoft's OLE (see the text box "Signs to Cairo" on page 126). By the time this scenario is realized, maybe they'll have stopped squabbling and be compatible with one another.

Portrait of an OOOS

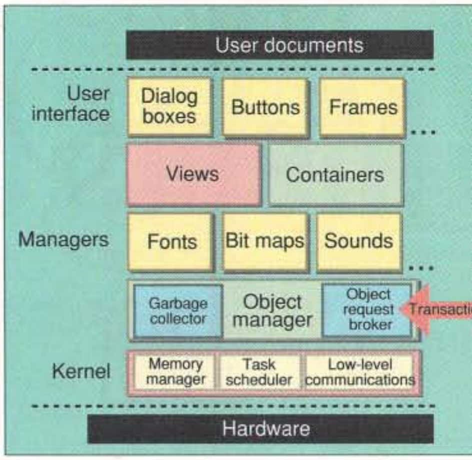
The purest form of an OOOS could hardly be simpler in concept: A small microkernel talks to the computer hardware, and the rest of the OS consists of replaceable modules, or objects. Outside the kernel code, there's no distinction between the OS, utilities, and applications. Everything is an object. A generic architecture for such an OOOS might look like the figure on page 124.

Objects are bundles of data with associated code that can act on the data. Anything from a business letter to the word processor that edits it can be structured like this. Program execution occurs when objects exchange messages, causing the kernel to execute their code. The kernel provides such low-level hardware-dependent services as memory allocation and protection, task scheduling, and communication (both process-to-process and remote). The kernel of an OOOS should be multitasking so that many objects can execute simultaneously. It should support automatic garbage collection of dead objects to avoid memory leaks.

An object manager uses kernel services to dynamically create and destroy transient objects and to preserve objects that will be needed in the future (e.g., user documents) in the persistent object store, a repository of objects available to all applications. When a program invokes an object's unique object identifier (OID), the object manager fetches it from the store into RAM.

In a fully distributed OOOS, an ORB translates requests for OIDs into network messages that find objects and transparently relocates them onto the local system. ORBs maintain indexes of various object attributes, so they're closer to a database manager than a conventional file system. An OOOS will update objects using transaction-based semantics, with commit and rollback so that any action can be undone. Remote communication will operate on a fault-tolerant store-and-forward basis, transmitting data when a link can be established and hiding delays from the user.

OOOS support for inheritance—creating new objects by modifying old ones—can save programmers from reinventing the wheel and users from wasting storage space. For the designers of OOOSes, however, inheritance is a headache. Child objects frequently execute code belonging to their parent, but that parent may live elsewhere on the network.



In a pure object-oriented OS (OOOS), everything above the kernel is a replaceable object, and files are abandoned in favor of persistent objects that are transparently moved between memory and mass storage.

The most difficult technical challenge for an OOOS is to avoid massive and unpredictable network overload due to tangled inheritance webs. The solution may lie in message-optimization schemes that group interdependent objects close to one another, dynamically migrating them where necessary.

Program objects under an OOOS will be finer-grained. A word processor would not be a single object, but a spelling checker or a search engine might be. The same spelling-checker object would check reports, presentations, or spreadsheets.

Real OOOS

The most pure OOOSes thus far are on personal digital assistants (PDAs), where engineers started from scratch with little legacy code. RAM-based persistent object storage (eliminating battery-powered rotating magnetic storage media—and the conventional file system) is a feature of Apple's Newton and General Magic's Magic Cap. The code reuse under a properly designed inheritance hierarchy reduces the size of software—a major consideration for PDA vendors when everything has to fit into 4 MB of ROM.

On the desktop, going to a full OOOS means making compromises to preserve legacy code and data, especially over the file system. Because all our existing data is in conventional files on conventional magnetic media, it has made commercial sense to continue supporting these rather than

Object Babel

The biggest obstacle to the wider adoption of object-based systems is their lack of interoperability: You can't transport objects from one OS to another without some conversion process. The only way to demolish this Tower of Babel is to adopt standards for object interoperation at three levels: for object creators, object users, and interobject communication.

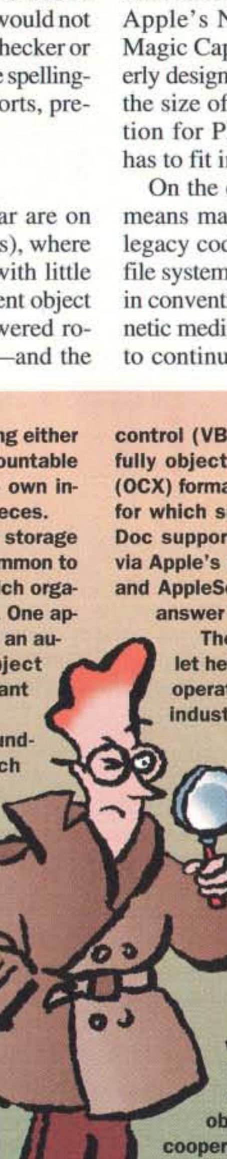
For object creators (i.e., vendors), we need a standard object model that specifies the binary formats for storing object data and sending messages. This model should also dictate the means of inheritance. The two contenders on the desktop are Microsoft's Common Object Model (COM) and IBM's System Object Model (SOM). Naturally, they're incompatible. In the wider computing world, several competing object models further muddy the water, including SQL3, the next major version of the query-language standard.

At the second level, object users need a standard way to embed objects into compound documents. The two competitors are Microsoft's OLE 2.0 and OpenDoc (supported by a consortium including Apple, IBM, Novell/WordPerfect, and Sun). A compound document that is stored using either technology is more like a whole mountable volume than a single file, with its own internal "directories" to store the pieces.

OLE 2.0 implements structured storage via a file format called a *docfile* (common to Word, PowerPoint, and Excel), which organizes objects into internal *streams*. One application can drive another through an automation interface by calling object methods that all OLE 2.0–compliant applications must make visible.

OpenDoc, too, defines a compound-document format (Bento) in which document components (parts) are stored in directory-like streams (storage units). OpenDoc goes beyond OLE 2.0 by offering built-in version management. You can reconstruct any earlier version at will using stored changes. Also, while OLE 2.0 is proprietary and confined to Windows and NT, OpenDoc will work on Mac, OS/2, and Unix platforms.

OLE 2.0 appears to have the edge over OpenDoc in the reusable software component market. OLE 2.0 enhances Visual Basic's very successful Visual Basic custom control (VBX) file standard into the more fully object-oriented OLE custom control (OCX) format (which supports inheritance), for which success is also assured. OpenDoc supports end-user programming only via Apple's rather old-fashioned HyperCard and AppleScript, and it badly needs some answer to Visual Basic.



The final standard needed would let heterogeneous object systems cooperate across a network. The cross-industry Object Management Group (OMG) has produced a standard for a Common Object Request Broker Architecture (CORBA)—the software layer that mediates requests between one object world and another. IBM's Distributed System Object Model (DSOM), which underlies OpenDoc, is CORBA-compliant. While the first version of CORBA was severely limited in that it allowed communication only between systems using the same object model, CORBA 2 supports cooperation between any CORBA-compliant systems. However, Microsoft has indicated that Cairo's OLE 2.0 will not be CORBA-compliant, dealing a heavy blow to the standard.

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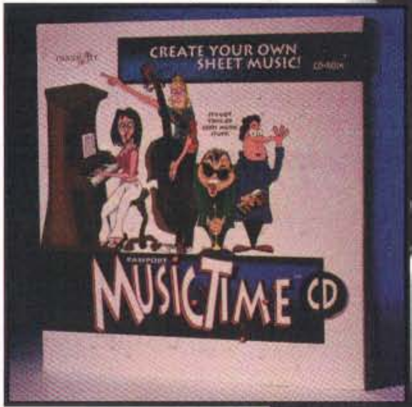

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Signs to Cairo

Cairo, Microsoft's object-oriented successor to Windows NT, will begin beta testing in early 1996 for release in 1997. Although Microsoft is not revealing the full details of Cairo yet, there are enough clues within current Microsoft OSes to yield a good idea of how it might work.

The OLE 2.0 embedding model that integrates the components of Microsoft Office already contains the seeds of a future object-oriented file store in its structured-storage technology. Word DOC files, Excel XLS files, and PowerPoint MPP files share a common internal *docfile* format. The screen below shows the internal structure of a Word document that's embedded in a PowerPoint presentation. The internal stream structure of the combined file has taken on a tree structure, just like a disk directory, reflecting the embedding of its components.

If you open the document in PowerPoint and double-click on the embedded Word document, PowerPoint finds out what application owns it from the Windows Registry. The OLE engine then negotiates between PowerPoint and Word, and PowerPoint's toolbar morphs into Word's formatting toolbar so you can edit the Word document.

Now peek into the future. The top level will no longer be a separate application such as PowerPoint, but the Cairo desktop itself. The streams comprising the compound document will no longer be inside a DOS file allocation table (FAT) file system. Cairo's Object File System (OFS) makes the whole hard disk a single huge docfile that exposes its internal objects to the user.

The groundwork for a distributed object store is present, too, in the shape of Microsoft Exchange Server (MXS) and the OLE-automatable Jet 3 database engine. If you drop any structured-storage object (e.g., a Word file) into an Exchange folder, any custom properties you've defined become available as values to sort on or filter by. MSX is based on the ISO X.400 message transport and X.500 directory services, which, combined with Cairo's OFS, should be able to locate remote objects across a network. By the time Cairo is released, MXS might be absorbed into the OS.

In short, the migration from Windows to Cairo could be less drastic than expected, given that all your Office data files are already in a structured format that Cairo will understand. The much greater challenge for Microsoft is how to decompose monolithic applications such as Excel into collections of discrete lightweight objects. The OLE automation interface already requires that applications make some of their internal organs visible as objects, but that is not at all the same as delivering them as separate pieces. It could turn out that Microsoft will encounter stiff competition from Visual Basic custom control/OLE custom control (VBX/OCX) vendors such as Sheridan and MicroHelp, who have a head start because their products are already in bits.

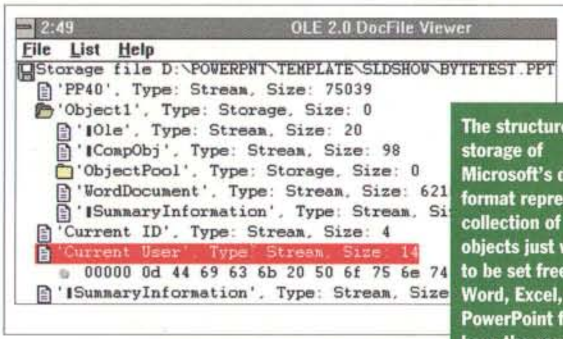
taking the radical step to a persistent object store.

For example, NextStep, the nearest thing to an OOOS in widespread use, is built on the Mach microkernel and employs a conventional Unix file system. However, the rest of the superstructure of NextStep is a hierarchy of Objective-C objects, fully available to the applications programmer.

IBM's OS/2 Warp is object-oriented to a much shallower degree. The Workplace Shell user interface (UI) is a programmer-accessible object hierarchy, but the lower levels of the OS are quite conventional.

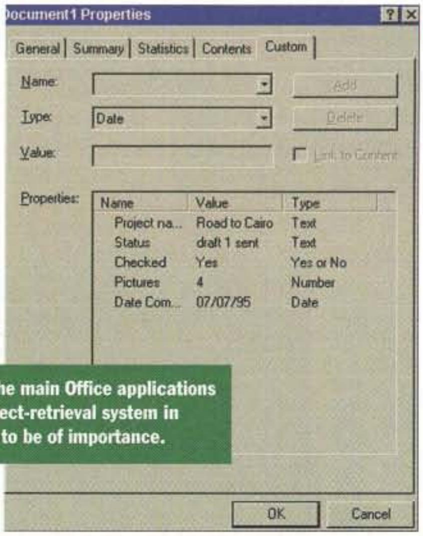
In 1992, IBM, Apple, and Hewlett-Packard set up Taligent to develop a new OOOS from the four years of research Apple had put into Pink. Last May, Taligent announced it had abandoned producing a whole OS and would instead release a cross-platform object-oriented *framework* (containing prefabricated application parts) called CommonPoint. In July, Taligent shipped CommonPoint source code to its sponsors to start porting to their own OSes (IBM's AIX and OS/2, Apple's Copland, and HP's HP-UX; versions for Windows 95 and NT will follow).

CommonPoint contains 100 such frameworks (including complete working and extensible text and graphics editors and presentation and communications programs), built from thousands of object classes. Taligent also has an interactive, drag-and-drop GUI building tool called cp-Constructor and plans for a highly sophisticated development environment.



```
2:49                    OLE 2.0 DocFile Viewer
File  List  Help
Storage file D:\POWERPNT\TEMPLATE\SLDSHOW\BYTETEST.PPT
  'PP40', Type: Stream, Size: 75039
  'Object1', Type: Storage, Size: 0
    '▮Ole', Type: Stream, Size: 20
    '▮CompObj', Type: Stream, Size: 98
    'ObjectPool', Type: Storage, Size: 0
    'WordDocument', Type: Stream, Size: 621
    '▮SummaryInformation', Type: Stream, Si
  'Current ID', Type: Stream, Size: 4
  'Current User', Type: Stream, Size: 14
     00000 0d 44 69 63 6b 20 50 6f 75 6e 74
  '▮SummaryInformation', Type: Stream, Size
```

The structured storage of Microsoft's docfile format represents a collection of objects just waiting to be set free. Word, Excel, and PowerPoint files all have the same internal structure, so embedding one in the other is easy.



ocument1 Properties

Name:

Type: Date

Value:

Properties:

Name	Value	Type
Project na...	Road to Cairo	Text
Status	draft 1 sent	Text
Checked	Yes	Yes or No
Pictures	4	Number
Date Com...	07/07/95	Date

Custom properties in the main Office applications point the way to an object-retrieval system in which filenames cease to be of importance.

CommonPoint may score over OLE 2.0/Visual Basic in its persistent object store (built on the native OS file system), so that applications objects remain alive at run time rather than being frozen at compile time: Programmers maintaining a delivered application can extend it using inheritance. On the downside, CommonPoint is very expensive and very, very large.

It's the long wait for Taligent that has caused a widespread feeling that object technology has failed to catch on. The fact is, OOOSes are just around the corner.

Isn't this where we came in? ■

Dick Pountain is a BYTE contributing editor based in London. You can reach him on the Internet or BIX at dickp@bix.com.

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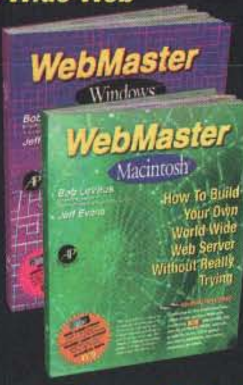

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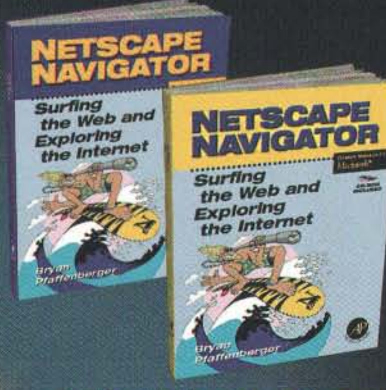

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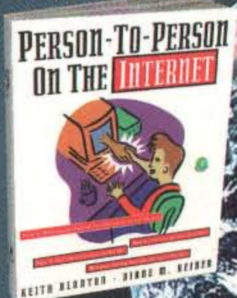

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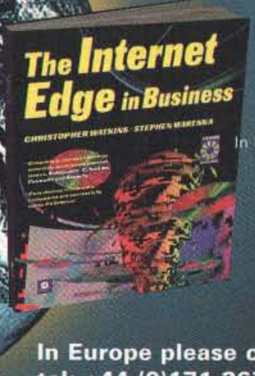

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- Six-bay desktop case with two cooling fans
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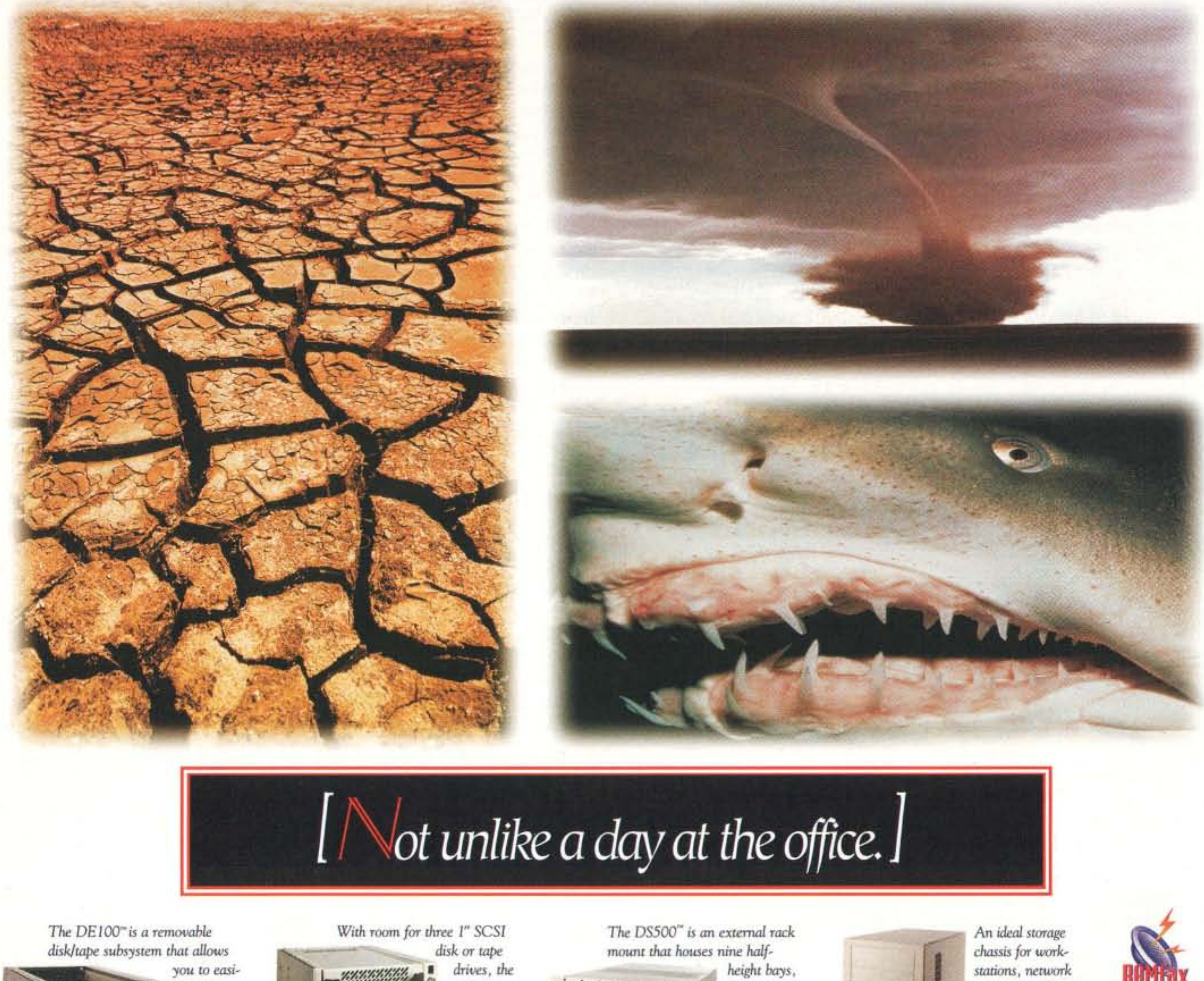

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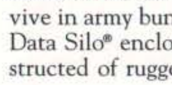

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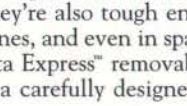

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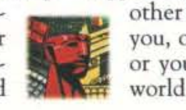

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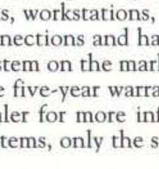

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And One for All

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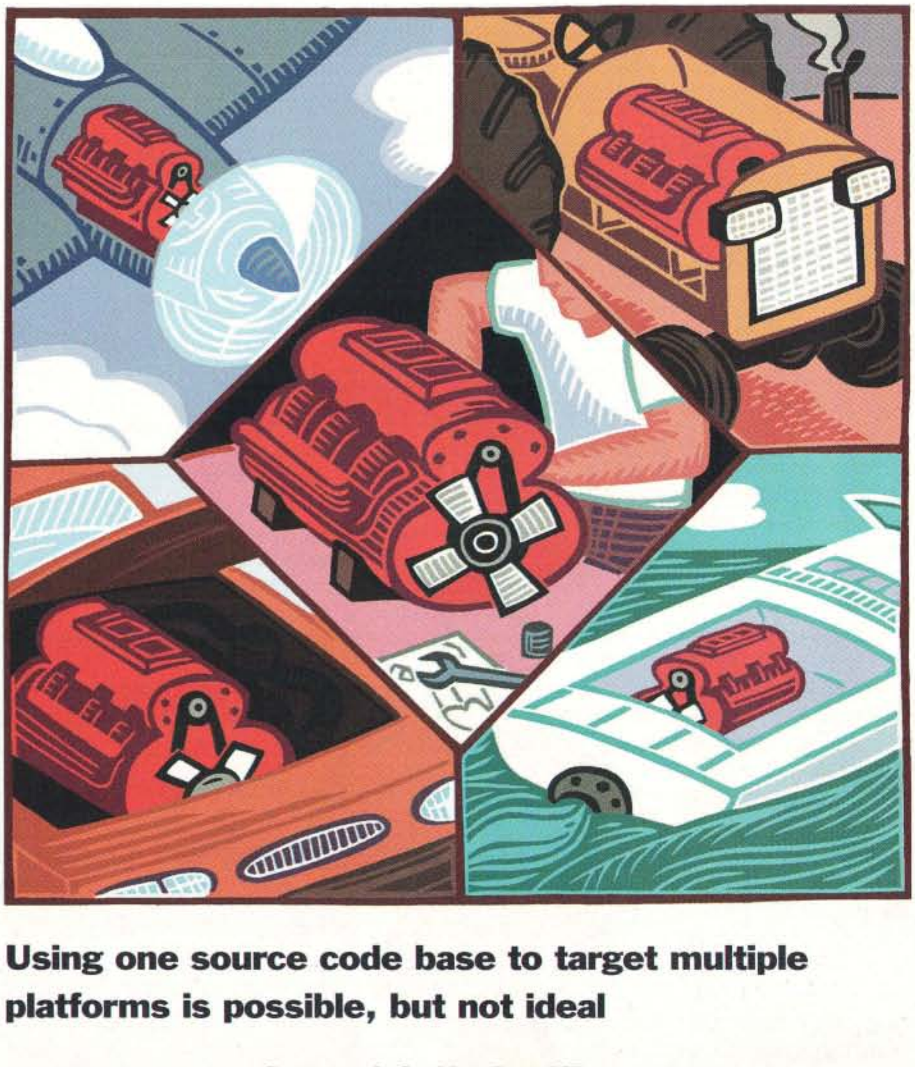

SCOTT BALDWIN © 1995

Using one source code base to target multiple platforms is possible, but not ideal

The four programmers draw their épées and simultaneously raise them to the sky. "All for one," they exclaim, "and one for all!" Such is the way of multiplatform development.

The ability to move an application from OS to OS, from GUI to GUI, and from processor to processor is a desirable, if elusive, goal. But the various environments in which we deploy applications have little in common, and environment-neutral development tools must create an additional layer to accommodate their differences. With this kind of architecture, it's difficult to expect excellence from a multiplatform application in all environments. Multiplatform applications are never a native, always a tourist.

"The problem with portable tools is that they never look native in any environment," says Robert Holmes, computer technology research analyst with the Southern California Gas Company (Los Angeles, CA). "They [tools vendors] simply can't be all things to all environments." Simply put, you pay your money and you make your choice: separate development for each platform, or multiplatform development only once.

As the cost of applications development rises, it makes sense to develop applications that run on a multitude of platforms. This allows companies to leverage their investment in code and more easily adjust to the inevitable technological changes. In addition, if you're marketing your applications, the more platforms they run on, the merrier your accountants will be.

Many tools vendors, including Compuware, Intersolv, Neuron Data, Unify, and Zinc Software, provide facilities for multiplatform development. When using these tools, developers can write an application once and then deploy it into many environments without modifying the programming code.

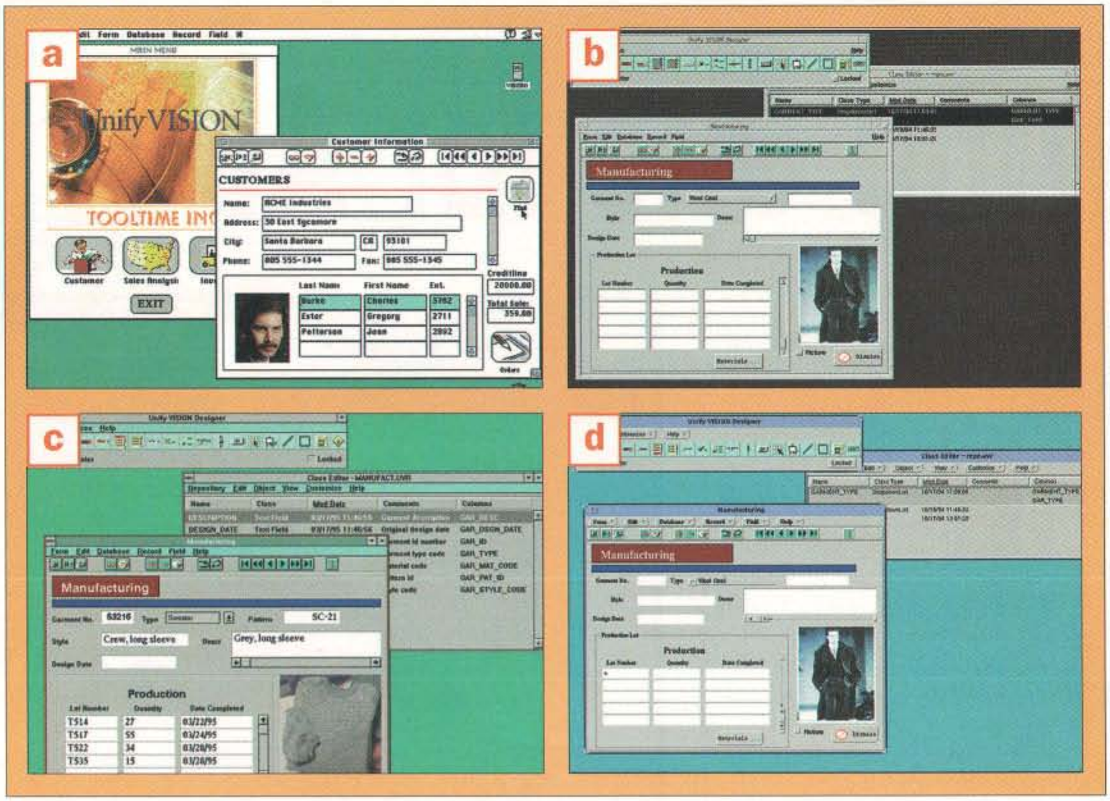
The trick for the developer is to find a tool that makes the application look at home no matter where it is. Some of the issues surrounding multiplatform development include approaches to portability, business justifications, pitfalls, tools, and how to win the portability game.

Desperately Seeking Portability

The idea of portability is conceptually simple: Keep the environment-specific code in its own layer. Then, when you move an application from platform to platform, simply swap out the old environment layer and swap in a new one.

For example, when developing a C++ application for portability, the developer places all the native GUI- and OS-specific code in its own object or group of objects. Then, when moving the application from platform to platform, the developer must replace just the native-object layer to redeploy the application in a new environment.

Most developers find that achieving true portability using traditional programming techniques is an arduous task. But a number of portable class libraries (e.g., C++ Views from Intersolv, zApp from Inmark Development, and Zinc from Zinc Software) and fourth-generation-language (4GL) tools (e.g., C/S Elements

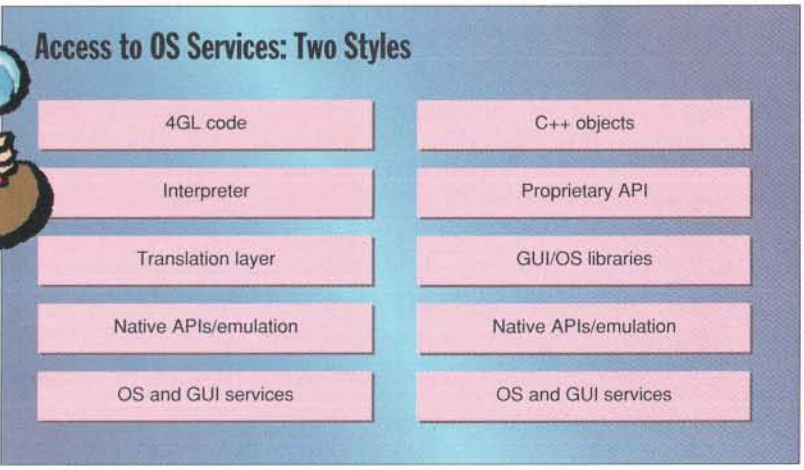


Unify's Vision provides multiplatform rapid application development for the Macintosh (a), Windows NT (b), Windows (c), and Unix (d). Vision's automated application-partitioning feature allows developers to partition applications across various applications servers.

from Neuron Data, Uniface from Compuware, Unify Vision from Unify, and VisualWorks from Digitalk/ParcPlace) are available to make the job much easier.

These tools provide a layered API framework. At some layer of this framework, the tools maintain the environment-specific code. Developers then build applications on top of the environment-specific layer.

By using proprietary API calls from third-generation-language (3GL) code, developers don't have to deal with the differences between native environments. The API provides a consistent set of available functions from compiler to compiler and from platform to platform to enable normal applications operations. It's the job of the tool, not the programmer, to handle the presentation of the application in the various environments supported by the portable development tool.



In one style of access (left), the development tool translates 4GL references into native calls. In another style, the tool supplies a proprietary API to which developers write code.

Although the basic concepts remain the same, there are many ways in which portable development tools approach the portability problem. These include lowest common denominator (LCD) and emulation. LCD tools (e.g., XVT from XVT Software) support those features found within all environments.

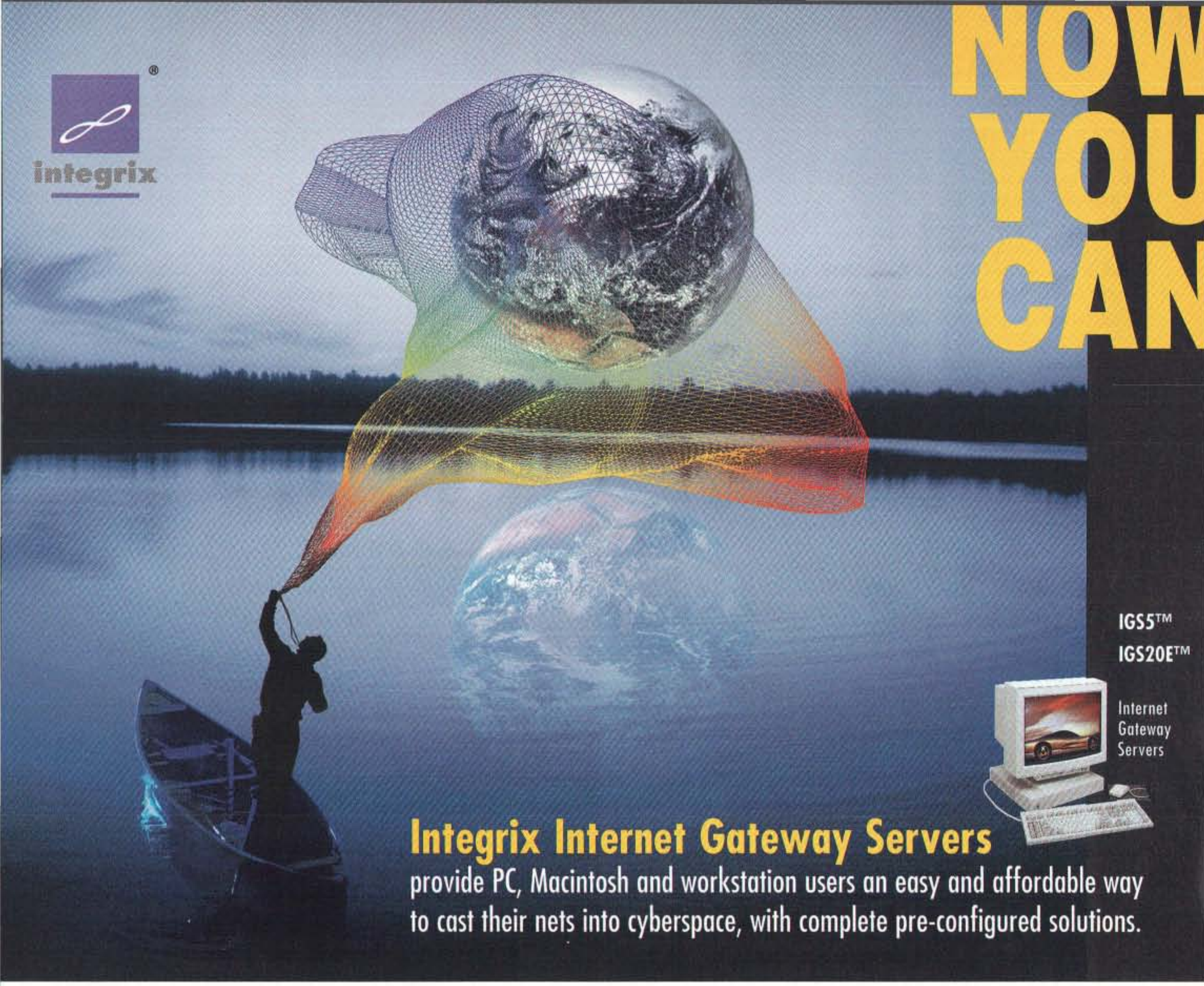
Yet to maintain portability, you have to give up some native application features. For example, LCD does not support nonportable features, such as Multiple Document Interface (MDI) for Windows applications or the geometry management found in Motif applications.

And while LCD provides the same look and feel across platforms, it doesn't consistently provide their *native* look and feel. For example, a Windows application built with an LCD tool looks out of place. But this can be an advantage. For instance, system administrators who manage many different types of systems may appreciate system-administration applications that look the same across all platforms.

In contrast, portable development tools that use emulation (e.g., C/S Elements) draw their own GUI controls for each environment. These tools go directly to the graphics subsystems of each specific environment, avoiding the native APIs. Again, these applications never really look at home, and bypassing the native API can cause other problems.

For example, by the time this article sees print, many people will have already upgraded to Windows 95. But portable applications built with emulation-based tools in the Windows 3.1 environment probably won't find a happy home with Windows 95: These applications rudely bypass its Win16 and Win32 native APIs. Or, even if the application does run, it will have a Windows 3.1 look and feel in the Windows 95 environment.

To correct this problem, the developer



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must rebuild the portable application using a new Windows 95 version of the portable development tool. The same is true for other platforms as well.

So, what's the best approach? It's no big surprise that the situation is not simply black and white. There are no clear differences between the LCD and emulation approaches to portable applications development when you consider the purchase of a portable development tool. In fact, most tools fall somewhere between the two approaches (e.g., XVT is more LCD, while C/S Elements is more emulation), and the only way to determine the efficiency of a portable tool's approach is to test it in the environments where you wish to deploy it.

But don't abandon all hope. There could be good news on the horizon for portable applications developers. As portable-tools vendors, such as Intersolv, work to improve their products, there seems to be a movement toward using more of the native APIs when deploying portable applications. This will eliminate many of the drawbacks of using portable development tools by making portable applications indistinguishable from native applications.

Thus, many tools, such as Intersolv's C++/Views, are moving to a *superset* approach to portability. Using this approach, portable tools build as many native functions as they can into portable applications. If any native functions are missing, the tools emulate the missing features. The resulting applications should provide all the native features you need while remaining completely portable. But using the native API makes a portable-tool vendor's job much more complicated, and it's going to take time before most tools move in the native direction.

Tools That Rule

Developers can divide portable tools into 3GLs and 4GLs. If you decide to go the 3GL route, you'll find a number of portable C++ libraries, including zApp, Zinc, and C++/Views. The basic idea behind these tools is that C++ developers will use these frameworks, which leverage the object-oriented aspects of C++, and place environment-specific code in their own libraries. Thus, when you switch platforms, you switch libraries as well.

Using portable C++ libraries, an application can access all OS and GUI services using the proprietary API of the tool, which in turn implements the proprietary API call using environment-specific calls. Since the tool API never changes from platform to platform, the applications are portable. You can, as an option, put environment-specific calls in your application using these portable frameworks. However, you'll have to either remove or work around those calls to make your application portable to other platforms.

As with any 3GL, developing portable applications using C++ takes a great deal of time and patience. To build portable applications in less time, you should consider portable 4GL development environments. Instead of using a proprietary API, 4GL tools provide a high-level language across platforms.

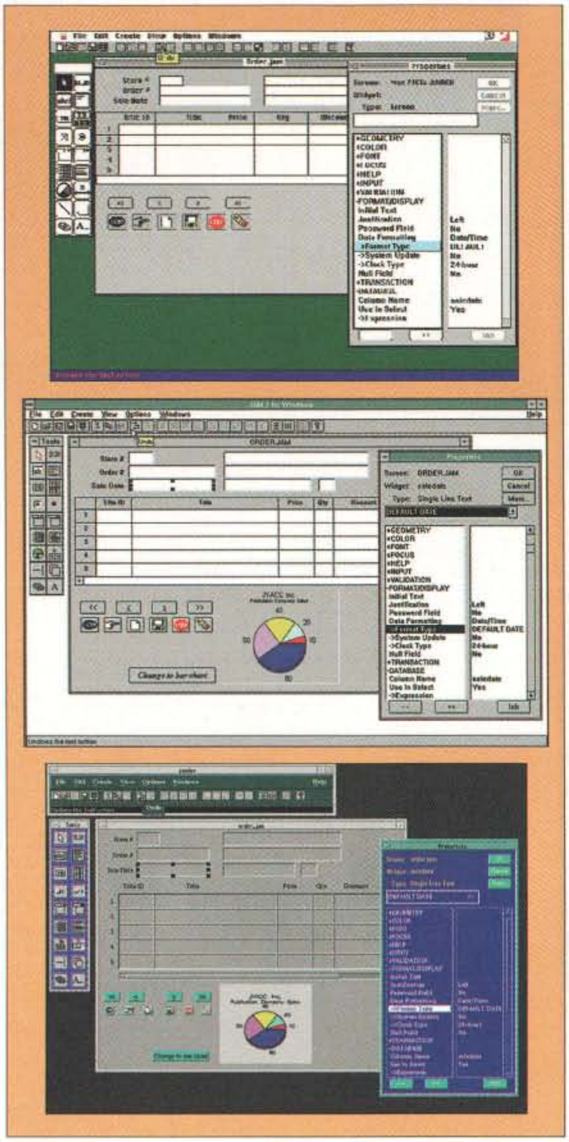
Examples of portable 4GL tools include C/S Elements, Uniface, and Unify. These tools use proprietary 4GL languages that sit on top of the environment-specific features of the tool. Uniface, for example, can deploy its 4GL applications on Windows, OS/2, Windows NT, Unix, and the Mac.

When selecting a portable 4GL tool, you should consider its ability to handle other application services, such as database-server connections, and its ability to assist in the development of a database schema. Many of these tools, such as Uniface and Unify, make good rapid-application-development (RAD) tools as well.

One drawback of portable 4GL tools is that they almost always use an interpreter, and therefore their performance is usually lackluster. With 3GL and 4GL tools, you need to check with the applications vendor to see if they support all the environments you plan to deploy applications on. Many tools support only a select few, or they support only one or two very well, while supporting others poorly.

Portable Traps

Despite the drawbacks, the allure of portability is just too strong for many organizations to resist. Most companies run a wide range of processors, OSes, and GUIs, and having to write an application just once for all those environments solves many problems. However, portability creates other problems. Failed portable applications development projects outnumber successful implementations, and it's clear that the honeymoon with portable applications development tools is over.



JYACC's Jam 7 is a multiplatform client/server applications development tool. Jam 7 applications are portable to (from top to bottom) the Mac, Windows, and Unix, plus other OSes.

The problem with building portable applications is traceable to the differences among platforms. Like "one-size-fits-none" gloves, portable development tools can't be all things to all platforms; therefore, they don't work exceptionally well on any of them. Most users can instantly discern a portable application from a native one and reject it as seemingly out of place.

For example, zApp, a useful portable C++ library that allows developers to deploy applications on Windows, Unix, Windows NT, OS/2, and Macintosh environments, looks a lot like a native Windows application no matter what platform you deploy it on. A developer may get away with this with Windows users, but not with anyone else.

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portable tools you have to give up other native goodies as well. Portable development tools that support Windows, for instance, might not have the mechanisms to use OLE 2.0 objects, Visual Basic custom controls (VBXes), or MDI. Moreover, they might make it difficult—or impossible—to use other third-party development tools and libraries.

Other issues are cost and performance. Most portable applications don't run as fast as native applications do, because of the overhead of using a native layer. In addition, portable development tools add significant cost to development projects, usually doubling the tool cost. You also need to consider staffing costs as well. Portable applications, especially in the 3GL world, take more time to develop, and their learning curve is steep.

Unarrested Development

Before jumping into portable applications development, take a deep breath and consider whether you really need to do so. Although vendors' sales pitches are compelling, if you don't have an immediate need to deploy applications on multiple environments, just say no. Multiplatform development adds both cost and trouble to the development life cycle. It's much easier to build native applications, and users are happier with them.

What if you decide to go native and get an unexpected demand to run your application on a different platform? The good news is that you can rebuild your application around a portable tool that handles the new platform. The bad news is that it requires a lot of additional work.

If portable applications development makes sense for your application, you need to consider the type of tools to use. While multiplatform development frameworks for C++ are flexible, they're difficult to learn and use. Moreover, it takes more time to build an application using a 3GL, such as C++, than it does with a 4GL.

Portable tools that use 4GLs offer an easier development environment, but—in support of the you-can't-have-everything theory—you might run into performance problems. For each type of tool, you always need to consider the OSes and GUIs that each works on. You probably want to set up pilot applications on all the platforms you're supporting as well. Never assume that your portable application will work the same across all platforms. Developers are often unpleasantly surprised at how widely tools-vendor support varies from platform to platform.

If you want to put advanced GUI features in your portable application, such as MDI, OLE, DDE, and Motif geometry, then make sure the tools support them. If you plan to use graphics, make sure the tools can display and print the graphics for your application on each platform.

You need to look at other details as well. For example, some portable applications development tools don't use the native help systems or the native help file; others don't use native fonts or bit maps. As always, it's caveat emptor.

Finally, when considering getting into the portable applications development game, use common sense. Determine your application requirements and platform requirements up front. Next, research the different portable development tools and select the ones that meet your requirements. From there, test each tool to determine its viability. Don't be afraid to dump a tool if it doesn't meet your expectations.

While portable applications development has many advantages in today's heterogeneous world, there are many tradeoffs to consider when selecting a portable development environment. As tools vendors become better at building portable development environments, someday maybe all development tools will provide portability, settling all the problems once and for all. ■

David S. Linthicum is a technical manager with EDS in Falls Church, Virginia. You can reach him at 70742.3165@compuserve.com or on BIX c/o "editors."

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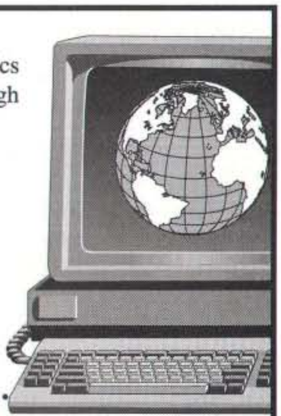

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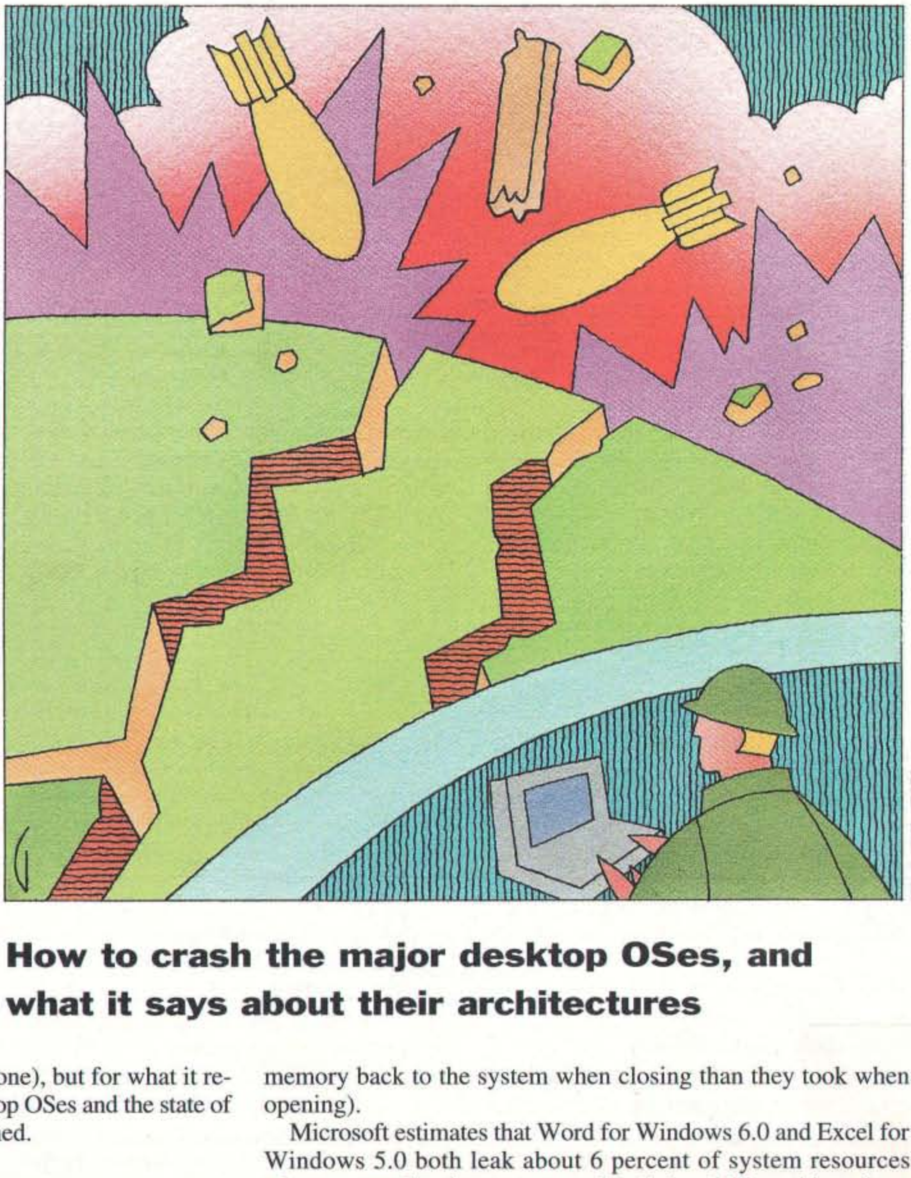

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How to crash the major desktop OSes, and what it says about their architectures

Although their fans speak of them in almost transcendental terms, the major desktop OSes sometimes exhibit all the rigor of a tube of toothpaste: You squeeze here, it bulges there; you squeeze there, it breaks. It's almost axiomatic in computer technology, of course, that every strength is simultaneously a weakness, and nowhere is this more apparent than in the crash performance of the major desktop OSes.

Under stress, Windows 3.1, Windows NT 3.5, OS/2 Warp, and Mac OS 7.5 (the PowerPC and Motorola 68000 versions) are all vulnerable to their own particular brands of system failure. They are often called General Protection Faults (GPFs) in the Windows world and system bombs on the Mac side. These flashes of woe (or whoa) typically render the active software application unusable and can freeze the whole system solid, requiring rebooting. As a bonus, you probably lose whatever you were working on, too.

Sometimes seemingly random system failures can at other times be replicated by following specific procedures, with near-scientific reproducibility. The following tour of the shores of computer hell is offered not for the sake of mayhem (or, at least, not for mayhem alone), but for what it reveals about the workings of various desktop OSes and the state of OS development. Forewarned is forearmed.

Breaking Windows

To crash Windows 3.1: Simply open and close Windows applications. Repeat a few dozen times, or until the Black Screen of Death appears.

The most popular OS is also the one that's most prone to total system meltdown. In fact, one of the dark facts about Windows is that you can cause Windows 3.1 and Windows for Workgroups 3.11 to crash simply by using them enough.

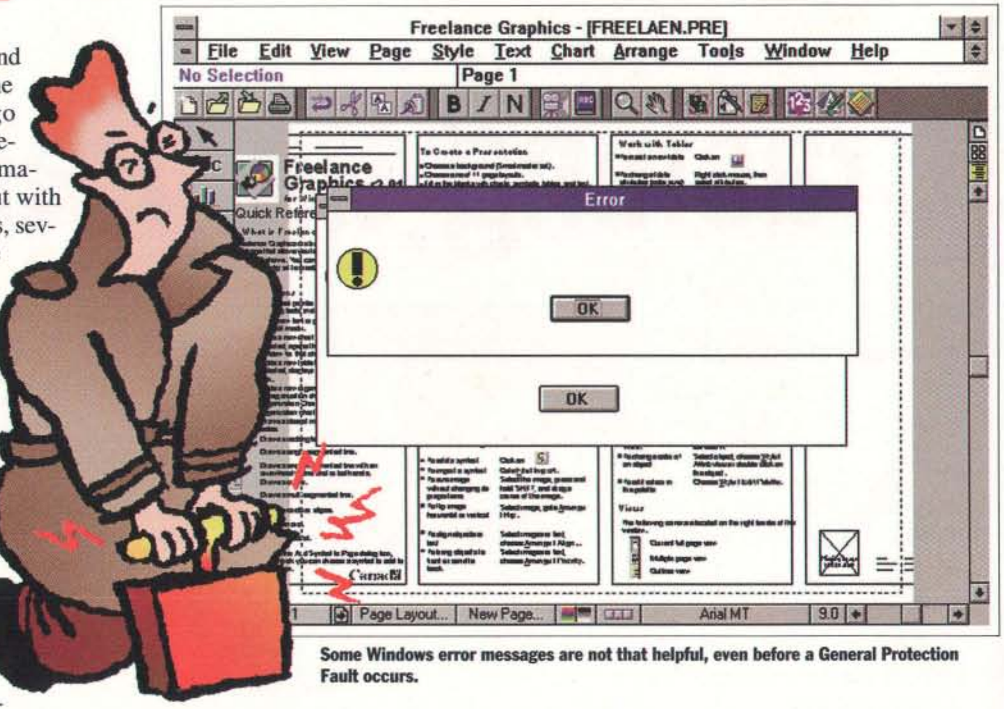
Windows 3.x is notoriously susceptible to potentially fatal memory leaks in two crucial 64-KB resource heaps used for system operation: USER.EXE and GDI.EXE. It's common for Windows applications to consume, or *leak*, memory (i.e., releasing less memory back to the system when closing than they took when opening).

Microsoft estimates that Word for Windows 6.0 and Excel for Windows 5.0 both leak about 6 percent of system resources whenever applications are opened and closed. Keep this up long enough, and the OS will choke—asphyxiated by lack of memory—and the system will crash. Thus, simply opening and closing enough Windows programs can eventually exhaust system memory and produce a GPF—even if you've got 100 MB of RAM installed.

There's an almost-infinite number of ways to bring on system-resource crashes in Windows 3.x. It's particularly (and ironically) easy with many Microsoft applications. For instance, if you insert a series of Microsoft Graph 5.0 objects into a Microsoft Word for Windows 6.0 document, you lose system resources every time you do so, until you eventually crash.

continued

Many Windows users exit from and restart Windows all day, not for the cool breeze of the Microsoft logo blowing by, but to replenish the depleted system resources on their machines. Although they may start out with 80 percent or more of free resources, several hours of hard use can leave them on the wrong side of the perilous 50 percent line, even with no applications open. One of the great attractions of Windows 95 is that it reduces—but does not eliminate—this problem.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Some Windows error messages are not that helpful, even before a General Protection Fault occurs.

Windows NT, a true 32-bit multithreaded OS, promises much greater stability than Windows 3.1, but it has still singed a few eyebrows along the way. Here's a recipe for a quick Windows NT disaster: With either Word for Windows 6.0 or Excel for Windows 5.0 running under Windows NT 3.1, close the program, reopen it, minimize it, and then quit again. Then listen for the splat. Microsoft acknowledges that this particular GPF is the result of a bug—not a feature—in the Windows-on-Windows subsystem memory manager in KRNL386.EXE.

In both Windows NT 3.1 and 3.5, available memory can also become exhausted if more than 100 threads or processes are launched simultaneously. The reason? The great insulation of applications from each other, which is one of NT's virtues, requires system overhead that can overwhelm the system. So, to protect against the sort of bumper-car GPFs that plague Windows 3.x, Windows NT introduces at least the slim possibility of another sort of calamity. "Quis custodiet ipsos custodes?" (translation: "Who shall guard the guards themselves?") is what you're probably saying to yourself at this point.

Protection...for a Price

OS/2 Warp, Windows NT's main high-end 32-bit competitor in the OS wars, has trimmed its sails in a somewhat different fashion. One of OS/2's virtues is that it's more sentient about hardware than Windows is. It can actually tell if your system has a bad memory chip, a floppy drive controller heading south, or even a loose add-in card.

But OS/2's hardware intelligence has a downside. Here's a way to quickly produce the "trap 0002" or "trap e" meltdown in OS/2 Warp—and probably burn up thousands of dollars in consultant fees, too. Open up the case on the system and slightly loosen one of the add-in cards (a network interface card [NIC] or modem will do nicely). Don't take the card out; just loosen it a little.

You now have the makings of an exquisite little bit of misfortune. If you do it right, on a dual-boot machine you will then be able to run DOS just fine, but when you try to run OS/2, you'll get a black screen rudely slammed in your face.

Consultant Chris White, who's based in West Sacramento, California, remembers running into this exact problem. "DOS ran fine, but I kept getting these bomb-outs all the time in OS/2," she recalls. It turned out that this was the beginning of a hardware failure that ultimately cost a great deal of lost data. "OS/2 was trying to warn me, but I didn't understand until it was too late," she explains. "At the time, I was just furious that the system would not work."

Also, while shielding applications from each other, as Windows NT does, OS/2 does not shield the OS from errant code as fully as NT does. A good deal of Warp code and data reside in portions of memory that are distressingly writable by all applications, which opens another door to memory conflicts and system crashes.

Sys! Boom! Bah!

Meanwhile, the Mac, like Windows, has its own heaps of memory trouble. Some Mac users report encountering strange names and arcane text on their screens during particularly showy system failures. These include the following:

```
_Jackson
+0000 408314A *Debugger
+0002 408314C _NewHandle, Immed
+0004 408314E BNE.S
   _DisposeCIcon+0032
```

These are vestiges of the original Mac development process. The name *Jackson*, for instance, is an abbreviated label for _JacksonPollock, the development code name for Color QuickDraw.

When Mac OS 7.5 users see the name *Jackson* amid the digital debris, they are probably in the grip of System Error 25, which can also generate out-of-memory errors and the bomb dialog box if MacBug is not installed. Mac System Error 25 occurs when memory stacks and heaps collide. This is commonly caused by an improper calling sequence by an application, prompting the stack to grow until it overruns the heap. (Boom!)

Another type of memory issue causes

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system bombs on classic Motorola-powered Macs. It results from the code-swapping model that's used by Mac OS 7.5 when virtual memory or RAM Doubler is turned on.

Unlike the PowerPC version of Mac OS 7.5, the 68000 chip version-segments code so that it doesn't have to be loaded into memory all at once. This is an advantage in some respects (especially on machines with limited memory and disk space), but it can lead to situations where there isn't enough memory left to load a particular program's code into RAM when the time comes. (Bawoomba!)

PowerPC machines running Mac OS 7.5 are designed to overcome this problem, but in the process they introduce a new type of crash. The PowerPC version of Mac OS 7.5 *doesn't* segment and swap code, and therefore it requires that enough memory—virtual or otherwise—be available to load a program's code into memory all at once.

To crash Mac OS 7.5 on the PowerPC: To crash a PowerPC system with less than 16 MB of RAM, all you have to do is turn off virtual memory and RAM Doubler, and then reboot the machine and try to run Adobe Photoshop. (MacSplat!)

Crash-Test Dummies?

So, what's the moral of all this sorrow? It's not necessarily that every desktop OS is a disaster waiting to happen, nor that everyone's data is doomed. The problems discussed here do not plague every desktop user every day. In fact, they are rare enough that many users may never see them at all.

Yet in a general sense, the crash characteristics of the major desktop OSes reveal some fundamental OS verities. One is that, like military generals, OS designers often seem to be fighting the previous war (e.g., Mac OS 7.5 for PowerPC versus Motorola 68000, or Windows NT versus Windows 3.1). Another is that the major OSes are all essentially involved in the same trade-offs (or deals with the devil) when it comes to protection against showstoppers. Each has gleaming strengths, and each has potentially mortal weaknesses.

Users should remember that each OS represents a real-world compromise. And you know what the real world is like. ■

Bruce Brown is the editor of the BugNet electronic newsletter and is based in Sumas, Washington. He can be reached on the Internet at bugnet@bugnet.com, on the World Wide Web at http://www.bugnet.com/~bugnet, or on BIX c/o "editors."

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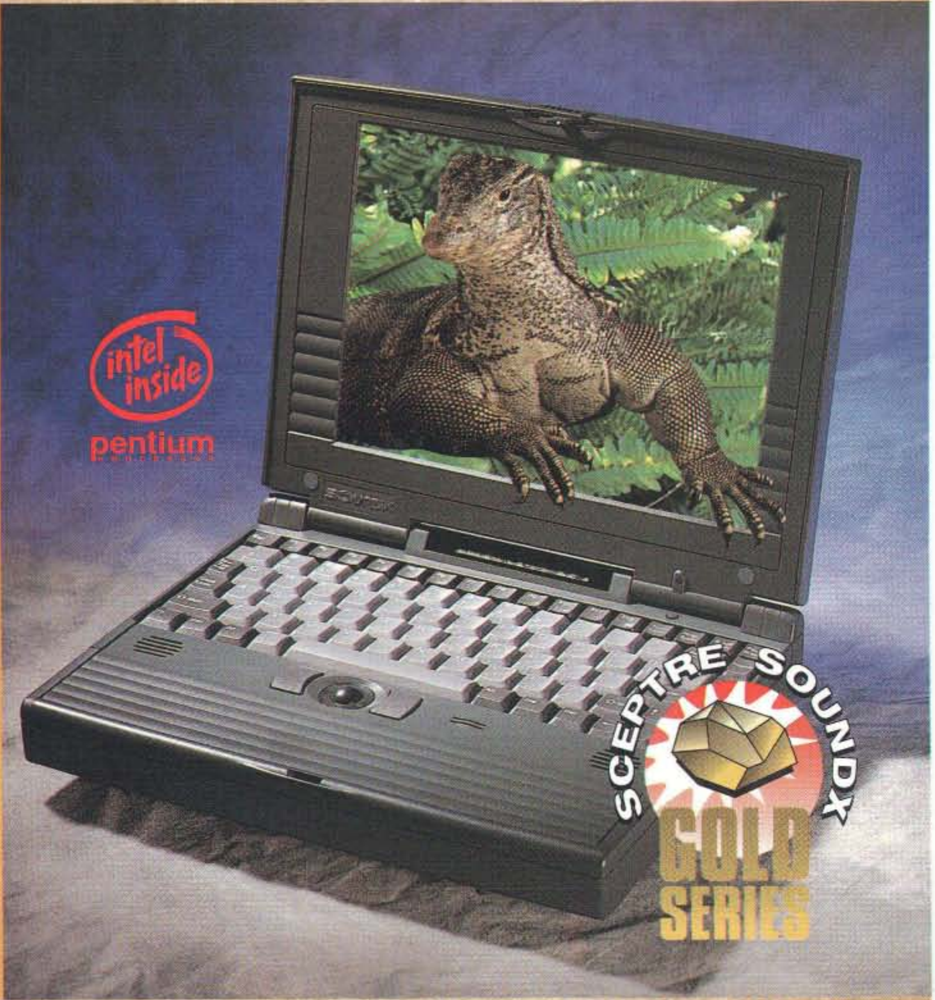

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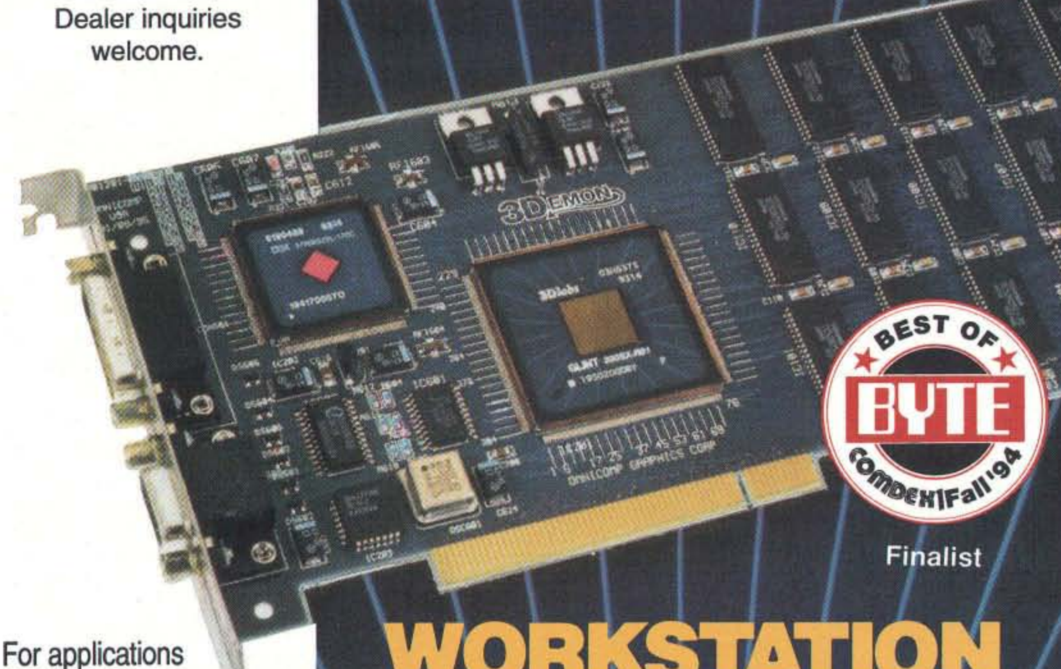

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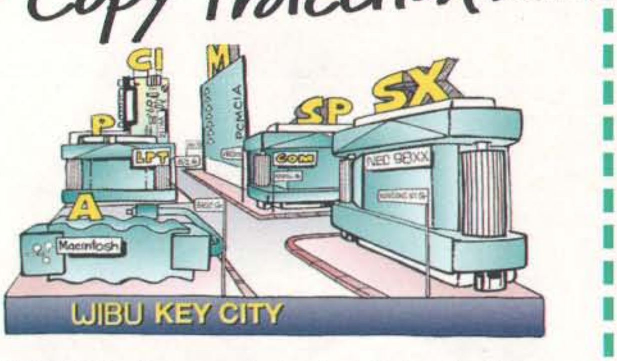

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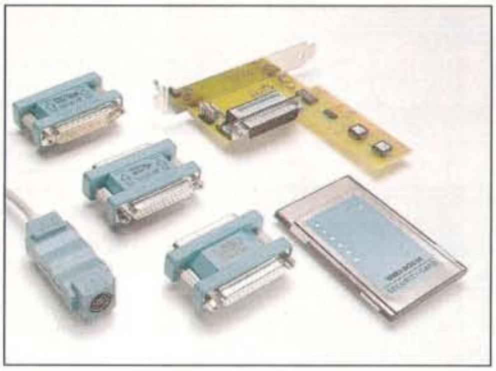

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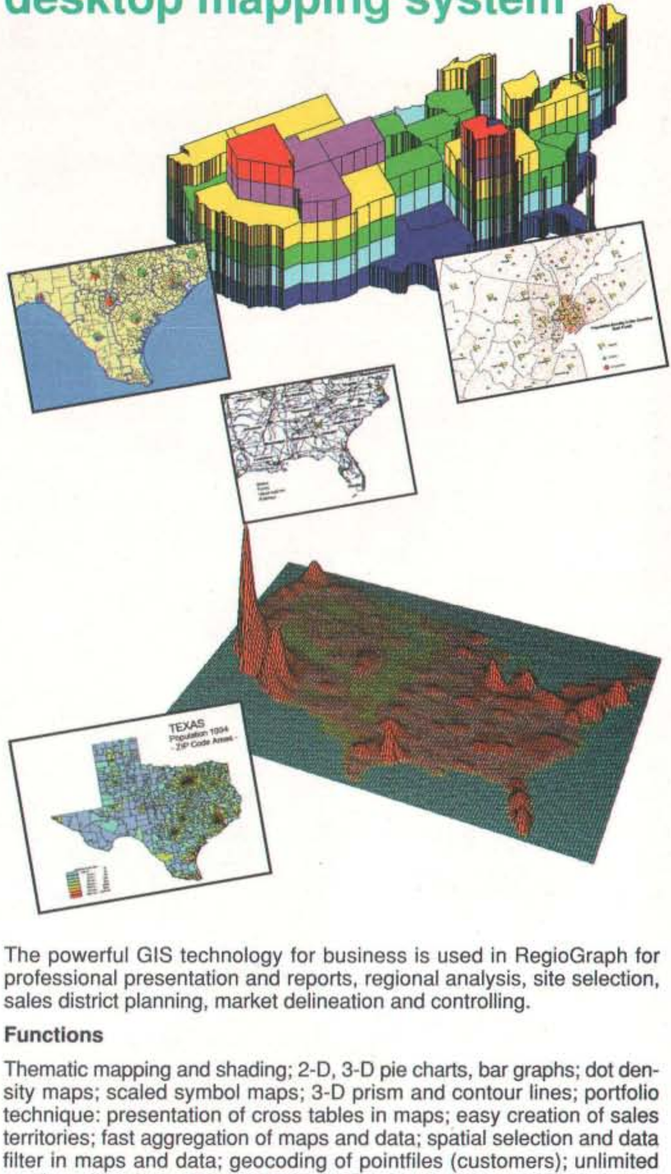

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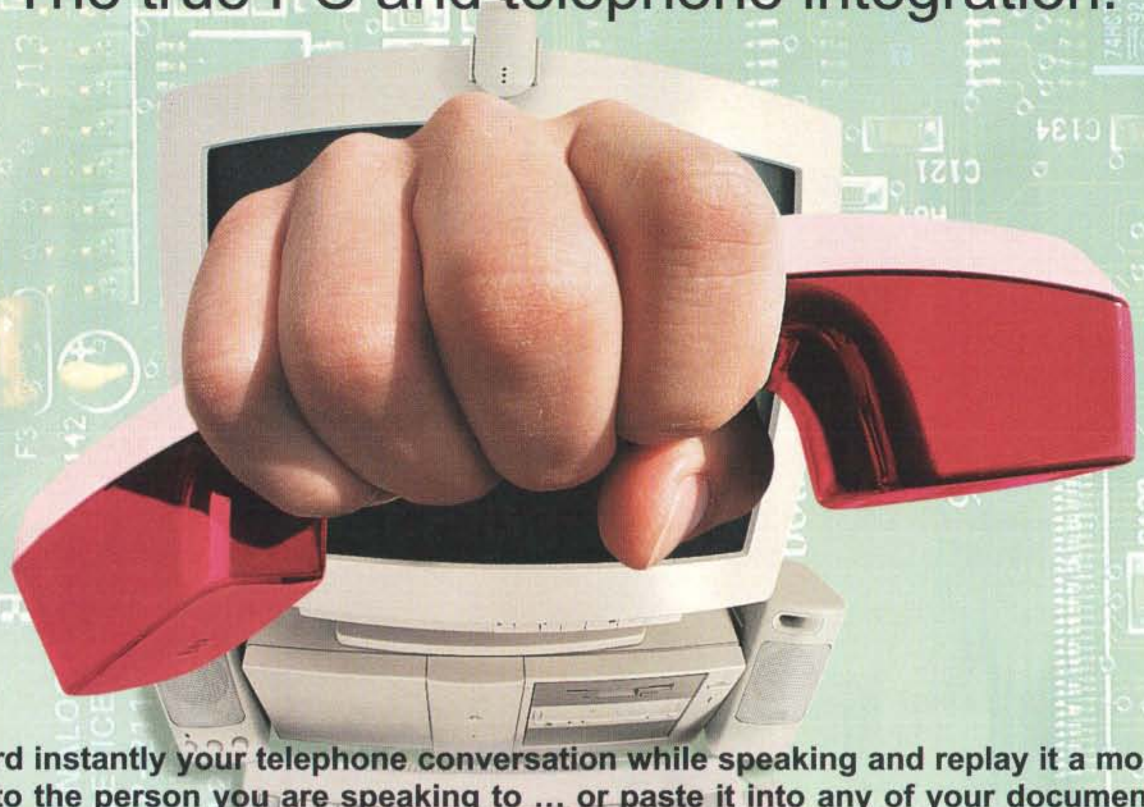

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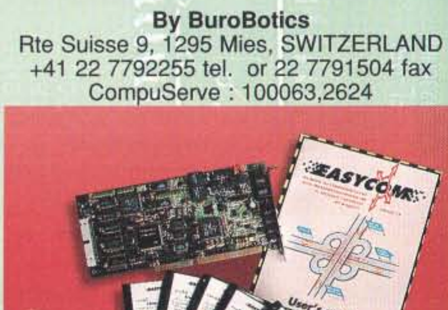

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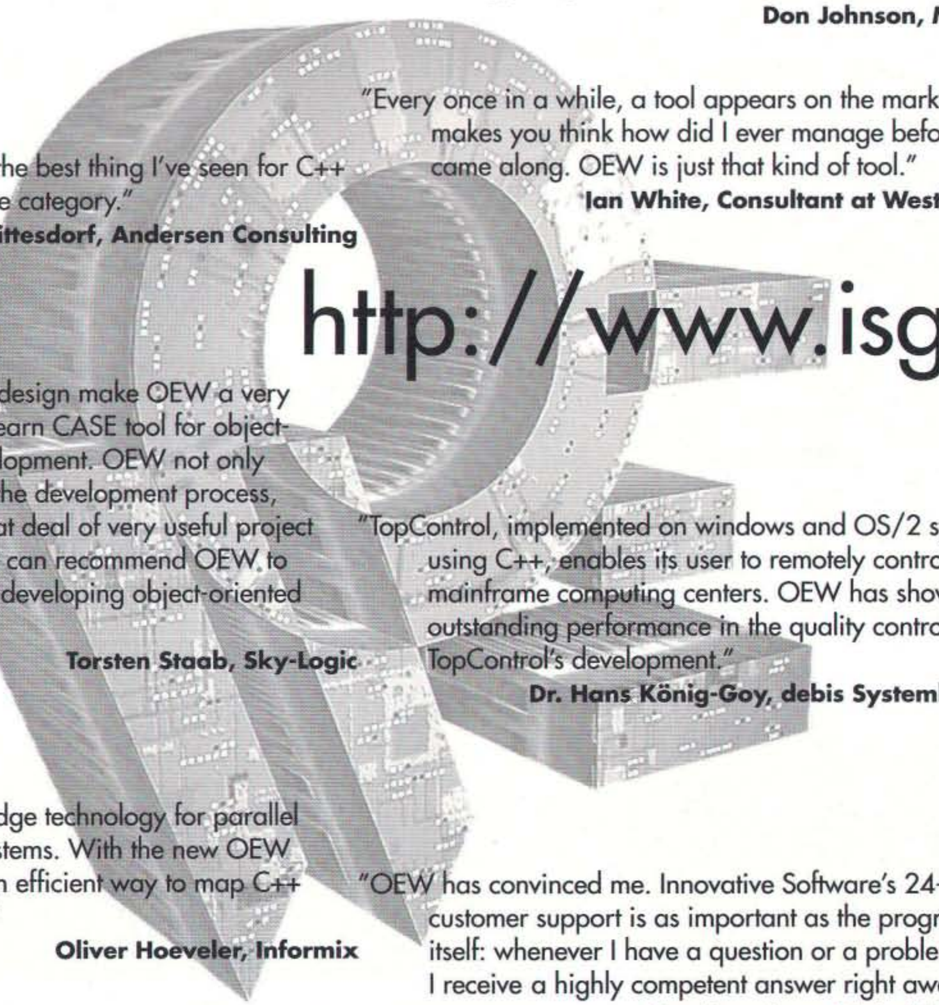

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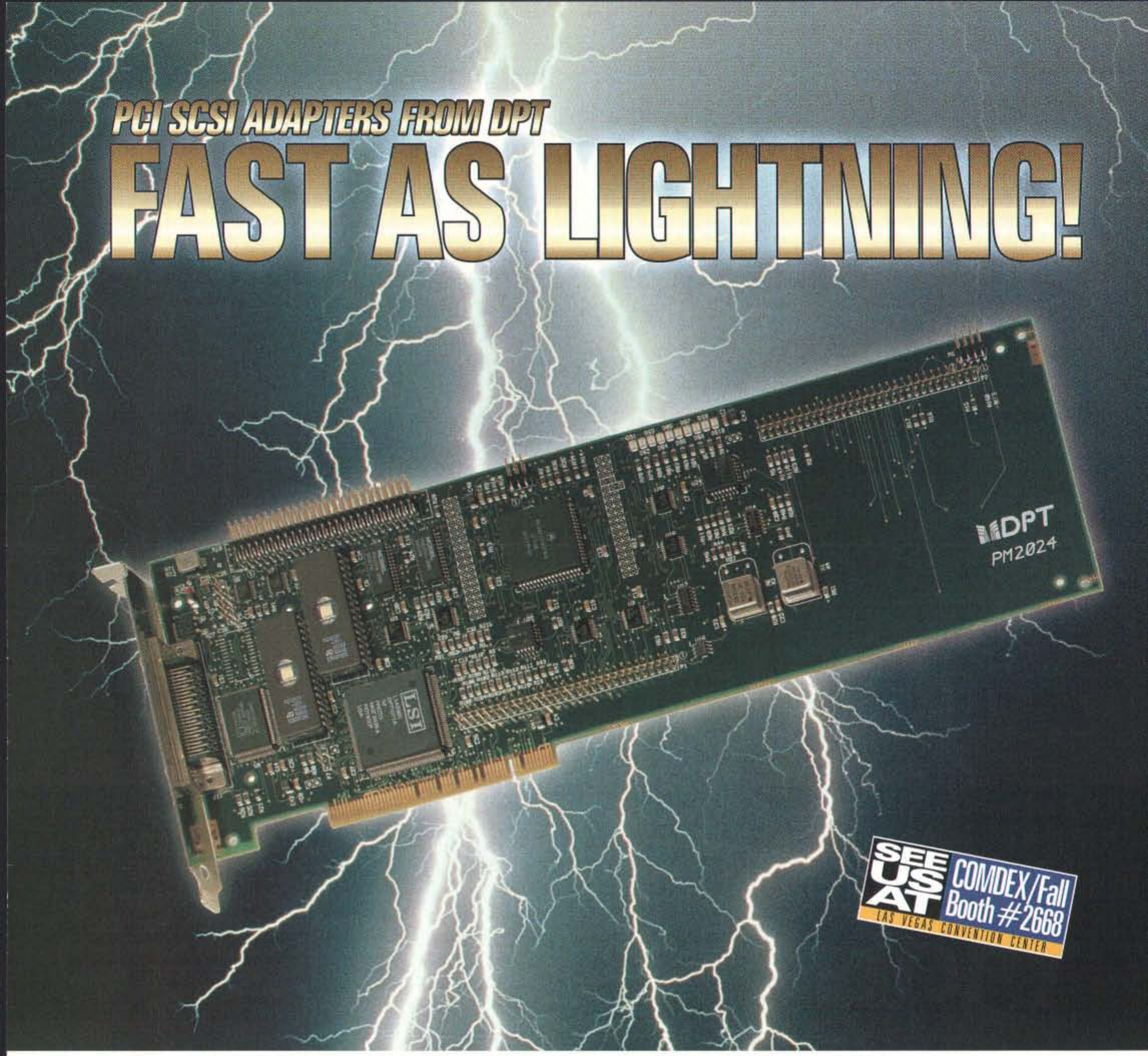
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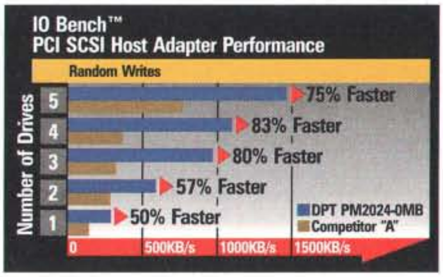

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When it comes to monitors, bigger is definitely better. And now is the time to invest because Orchestra has made the exceptional affordable. *PC Magazine, Byte, MacUser* and *CD ROM* magazines all agree that our 17" displays offer superior value. So replace your 14" monitor with a Tympani or Tuba II. Get all the multi-tasking workspace you need to be more productive. Jazz up your games, on-line services, CD-ROM's and World Wide Web pages. And do so, knowing that our quality, price and performance compose a rare value.

Specification Comparisons	Tuba II	Tympani	NEC XV17	MAG DX17F	Viewsonic 17G	NOKIA 447 Multigraph	NANAO F2-17EX
Dot Pitch (mm)	0.26/0.28	0.42	0.28	0.28	0.26	0.26	0.26
Maximum Resolution (Non-interlaced)	2000x2000	1024x768	1280x1024	1280x1024	1280x1024	1600x1200	1600x1200
Trapezoidal Control	•				•	•	•
Tilt/Rotation Control	•		•	•		•	•
Pincushion Control	•	•	•	•	•	•	•
Color Balance Control	•		•		•	•	•
Color Temperature Control	•				•	•	•
Microprocessor Controls	•		•	PARTIAL	PARTIAL	•	•
On-screen Controls	•		•		•	•	•
Estimated Street Price	$729	$469	$799	$799	$945	$1075	$1098

The Tuba II is our latest opus, with an ensemble of features to spoil you. It offers high resolutions and refresh rates, microprocessor controls and compliance for today's power consumption and emission standards. Our On-Screen Display system also enhances performance by controlling the following:

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- Trapezoidal Distortion
- Color Balance
- Color Temperature
- Tilt/Rotation

New Windows 95 users will appreciate Tuba II's fine 0.28mm dot pitch, 2000 x2000 maximum resolution and FST edge-to-edge big screen display. All this, with an estimated selling price of under $729. If you want a big, high-performance monitor at a holiday-budget price, choose the Tuba II.

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The Tympani features a maximum non-interlaced resolution of 1024 x 768, pincushioning controls and Energy Star compliance. It's the ideal monitor for the oversized display of games, CD-ROM reference content, on-line access services and general use applications, at a price that's truly music to your ears.

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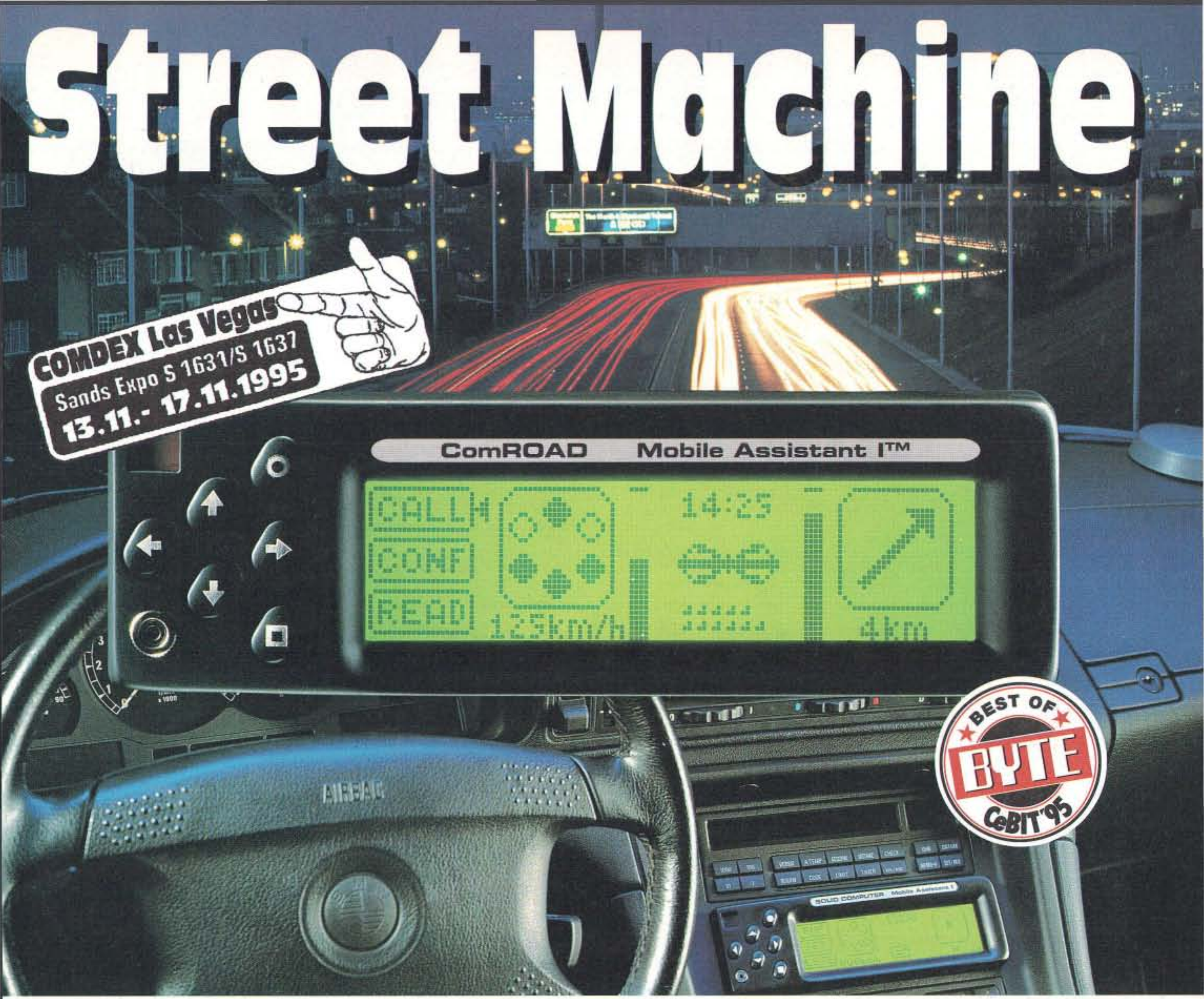

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Computer Graphics Metafile is the ISO/ANSI standard for system independent storage of vector and rasterbased graphical information. CGM is part of the worldwide CALS and ATA initiatives that optimize industrial processes and is implemented in hundreds of applications. Together with our partner, Henderson Software Inc., whose president Lofton Henderson is the technical editor of the CGM standard, EMATEK offers a complete product line of CGM tools.

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MetaPrint:	CGM printer driver for MS Windows.
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GKS-Standard

Graphical **K**ernel **S**ystem is a C and FORTRAN function library that enables you to develop portable graphic applications which include for example user interaction, coordinate transformation and object segmentation, based on the ISO GKS Standard. GSS*GKS, which is installed in large quantities on the DOS platform and has been proved successful for years, is now available for the graphical user interfaces and therefore offers the software developer a smooth transition to the new windowing systems.

CGI Print Manager for X11

Windows NT shaked the UNIX community decently. But on closer examination it is the numerous small features which make NT attractiv and which the UNIX system does not possess. For example the Windows Graphical Device Interface (GDI) is one of these features and allows every hardware manufacturer to develop device drivers and to deliver them with his devices. Hence every customer can, at any point, install additional drivers himself thus optimizing the use of his software. Up until now this is impossible under UNIX. But EMATEK has just developed a print manager for Motif/X11 on the base of the Computer Graphics Interface (CGI) standard. The final product will allow each X11-based application to address printers, plotters or output files through the CGI device interface. In addition, CGI as an ISO standard adheres to the UNIX open systems' philosopy.

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3. Competitive advantage:

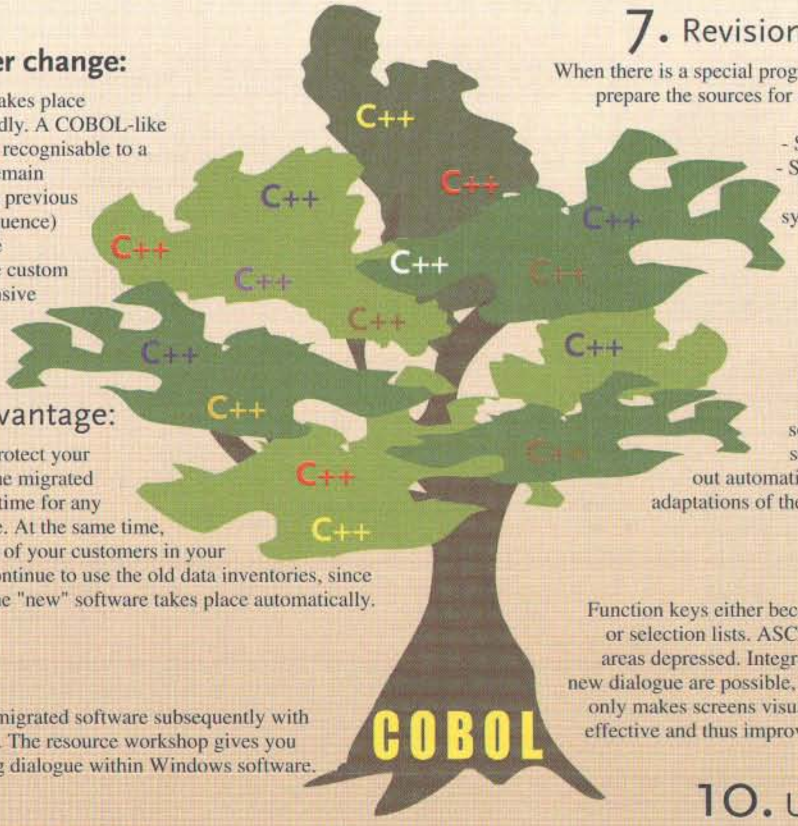
By migration of software, you protect your investment. Since you can use the migrated software immediately, you gain time for any new developments that you have. At the same time, you also protect the investments of your customers in your software. Your customers can continue to use the old data inventories, since data transfer from the "old" to the "new" software takes place automatically.

4. Flexibility:

In addition, you can extend the migrated software subsequently with additional dialogue and features. The resource workshop gives you all the facilities insert continuing dialogue within Windows software.

5. Multitasking/ergonomics:

With migration, you can utilise all the advantages of modern Windows software. Apart from the possibility of multitasking, the ergonomics, i.e. the usability of your programs is substantially enhanced.



6. Analysis of the program structure forming the basis:

Examines how the problem encapsulation is reflected in the individual COBOL modules. Usually the individual program functions are started from a central shell, which at the same time contains the menu management. Often, however, additional functions, such as initialisation and management of a global data area are integrated into this shell.

7. Revision of COBOL sources:

When there is a special program structure, it can be sensible to prepare the sources for migration. Possible steps here are:

- Consistent modularisation
- Separation from old menu systems
- Sub-division of the menu shell into individual components (menu system, management of global area)
- Make main modules capable of being separately run from the test environment

8. Migration:

After careful preparation of the sources, conversion of the COBOL sources into C++ sources is carried out automatically. Depending on the compiler, adaptations of the run-time libraries can still result.

9. Visual layout:

Function keys either become standard buttons in a tool bar or selection lists. ASCII graphics appear raised, inverted areas depressed. Integration of message boxes and use of new dialogue are possible, using the resource editor. You not only makes screens visually more attractive, but also more effective and thus improve the ergonomics of the software.

10. Use of class libraries:

The migrated programs are programs with run-times identical to the programs of the original software, on one hand, and on the other hand are pure message-driven programs, e.g. Windows. Therefore, newly-developped program code can be installed at any point in the C++ program code without restriction, using other class libraries.

● Advantages of migration ● Procedure for migration projects

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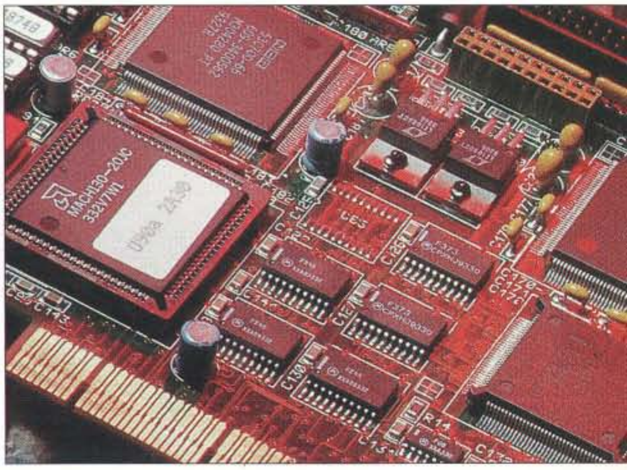

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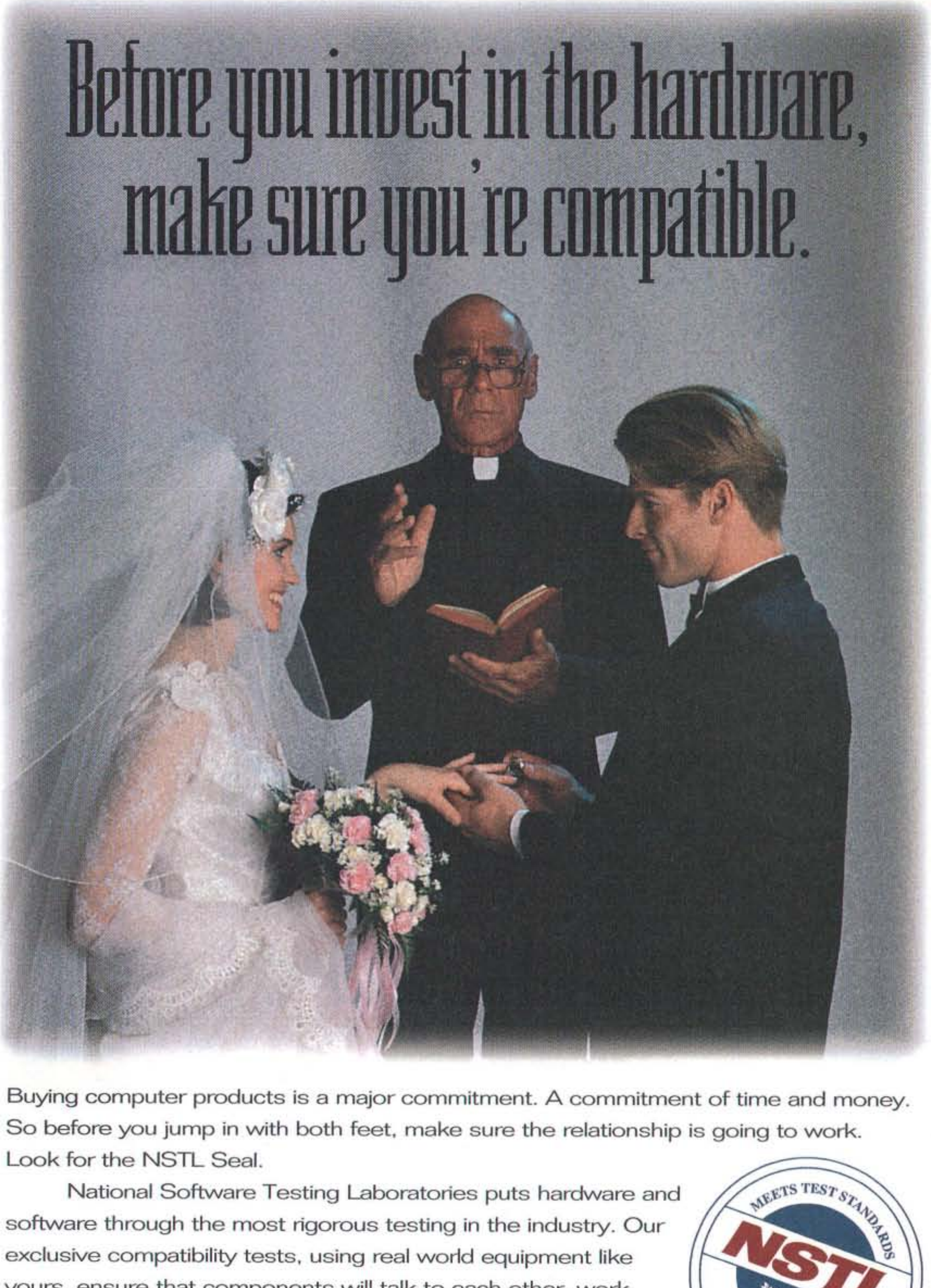
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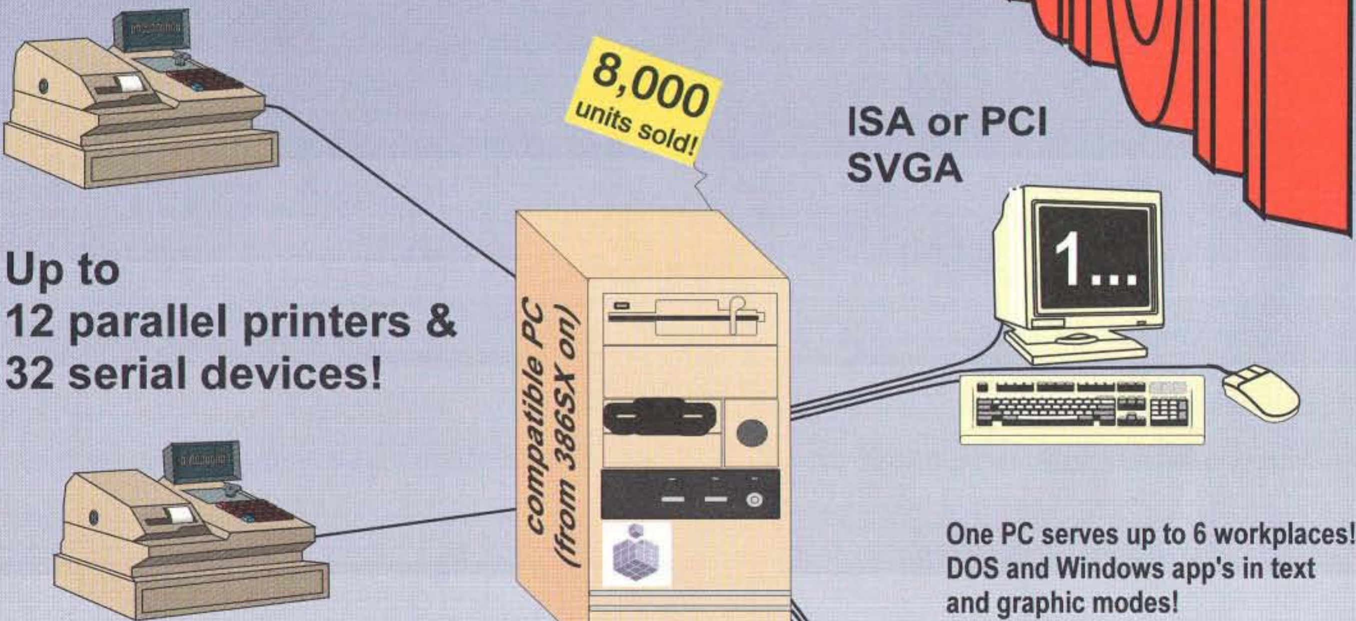
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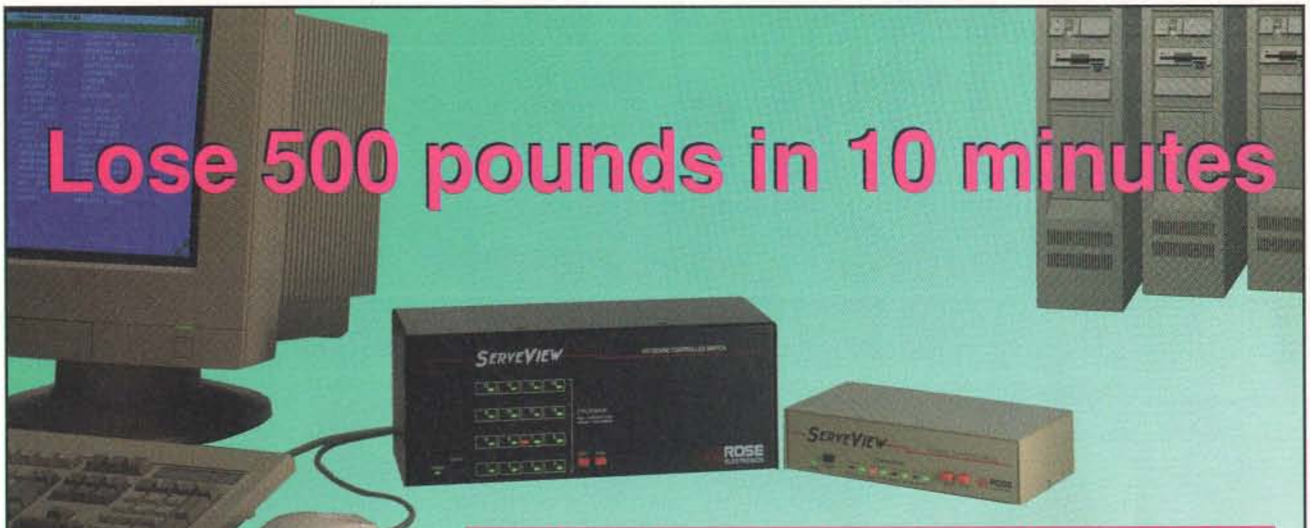
Circle 198 on Inquiry Card (RESELLERS: 199).



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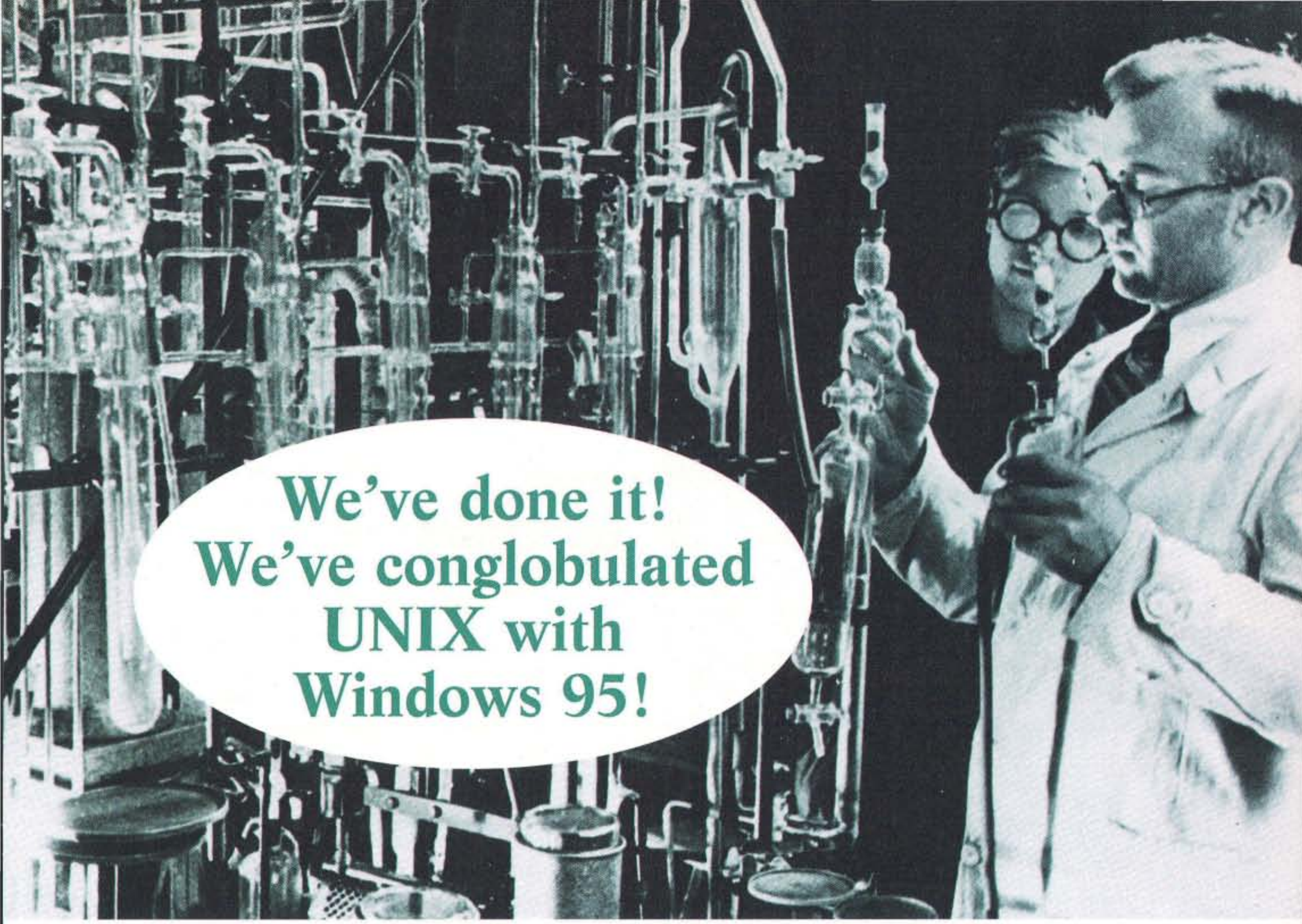
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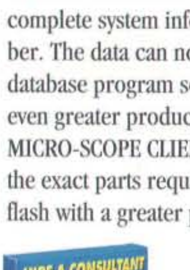

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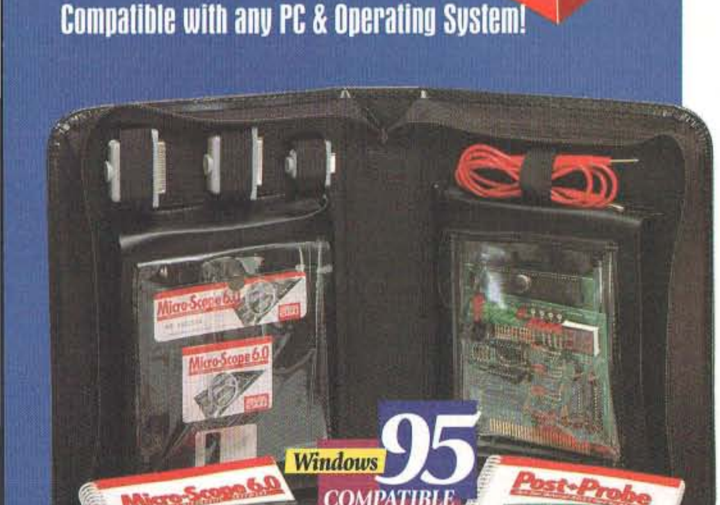

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Circle 200 on Inquiry Card.

MICRO 2000

Circle 212 on Inquiry Card (RESELLERS: 213).

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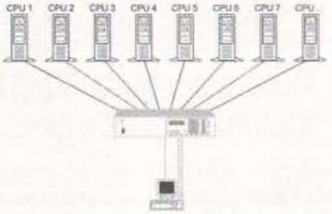
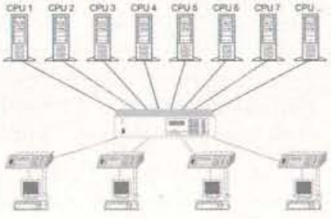


Multi access system

- Basic units available for 8, 16, and 32* CPUs
- access from consoles on up to four locations to many CPUs without interfering each other (real matrix)
- all features of the single access system build in

*) TBA



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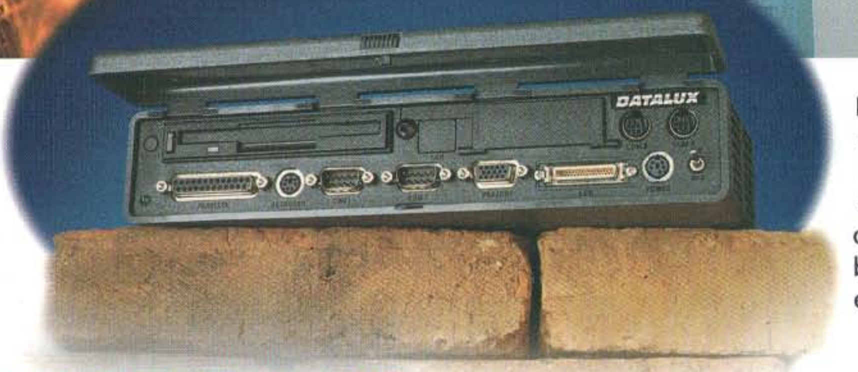

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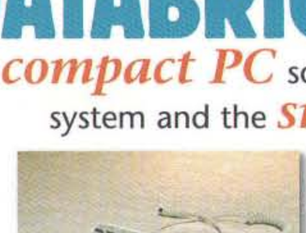

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The Space-Saver keyboard is the smallest full function 100 key keyboard available. With standard left right spacing touch typing is easy yet the overall size is only 6" x 10.75".
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DVS shown here on Rolling Stand

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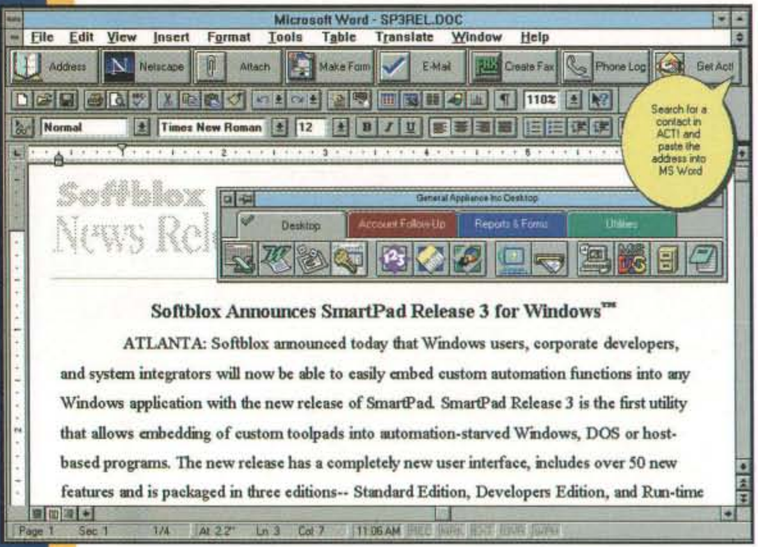
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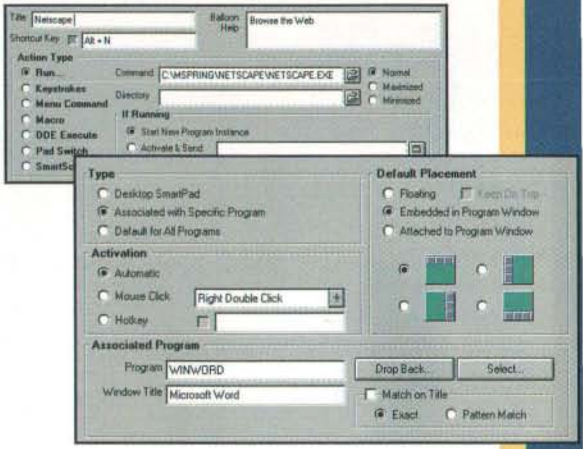
Softblox Announces SmartPad Release 3 for Windows™

ATLANTA: Softblox announced today that Windows users, corporate developers, and system integrators will now be able to easily embed custom automation functions into any Windows application with the new release of SmartPad. SmartPad Release 3 is the first utility that allows embedding of custom toolpads into automation-starved Windows, DOS or host-based programs. The new release has a completely new user interface, includes over 50 new features and is packaged in three editions-- Standard Edition, Developers Edition, and Run-time



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Shortcut Key: Alt + N
Balloon Help: Browse the Web
Action Type: ● Run...
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Directory:
● Normal
If Running: ● Start New Program Instance

Type: ● Associated with Specific Program
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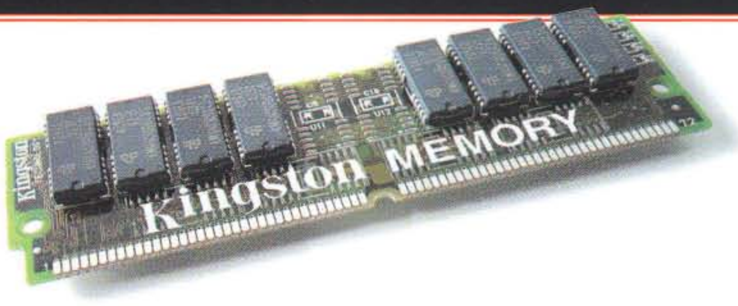

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HEART THROBS

CPU designers beg, borrow, and steal for every ounce of performance they can get

So many factors go into making a great computer. You need to consider I/O, storage, memory, and the display. Oh, and don't forget ergonomics; human factors are very important. But what *really* gets your heart pumping is what lies at the heart of today's best systems: the newest, most screaming, most radically designed CPUs.

We have become addicted to speed. Gordon Moore is our pusher. Moore's law, which states that processing power will double every year and a half, has thus far held true. CPU designers, always in search of a better fix, drain every possible ounce of fat from processor cores, squeeze clock cycles, and cram components into smaller and smaller dies.

They also steal ideas from each other. As "CPU Scorecards" shows, the line between CISC and RISC is getting blurrier every day, and the next-generation offerings from the major chip families continue this trend. The upside for us is that a SPECint95 score of 300 will soon be the high-performance midrange, and we'll be eyeing scores of over 500 by this time next year.

However, processors aren't just getting faster; they are becoming more specialized as well. Consider the handful of new multimedia chips that we describe in detail in "Chip Fashion."

Perhaps nothing epitomizes the merging of CISC and RISC and the rise of specialization more than IBM's stealth processor, the PowerPC 615. This single-chip marriage of PowerPC and x86 promises to run native applications from both platforms with little performance hit. Insiders say that IBM has been working on it for years and has found the design mind-numbingly difficult to build.

The latest round of rumors puts the chip's introduction sometime in 1996. IBM, which barely admits that the project even exists, won't talk technical details. So, we asked a leading expert on chip design, the *Microprocessor Report*'s Linley Gwennap, to design the 615 for us. As far as we know, this design, outlined in "Why the 615 Matters," isn't necessarily what IBM is working on, but the efficiencies of Gwennap's shared-memory model may be fodder for Big Blue's engineers.

Whether you admire CPUs inherently or just appreciate them as one of the many important system components, the technologies described in the following pages should raise your pulse. ■

—Alan Joch, Senior Editor

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A technical comparison of nine next-generation CPUs........179

Why the 615 Matters
Here's our design for natively running x86 software on a PowerPC CPU.....198

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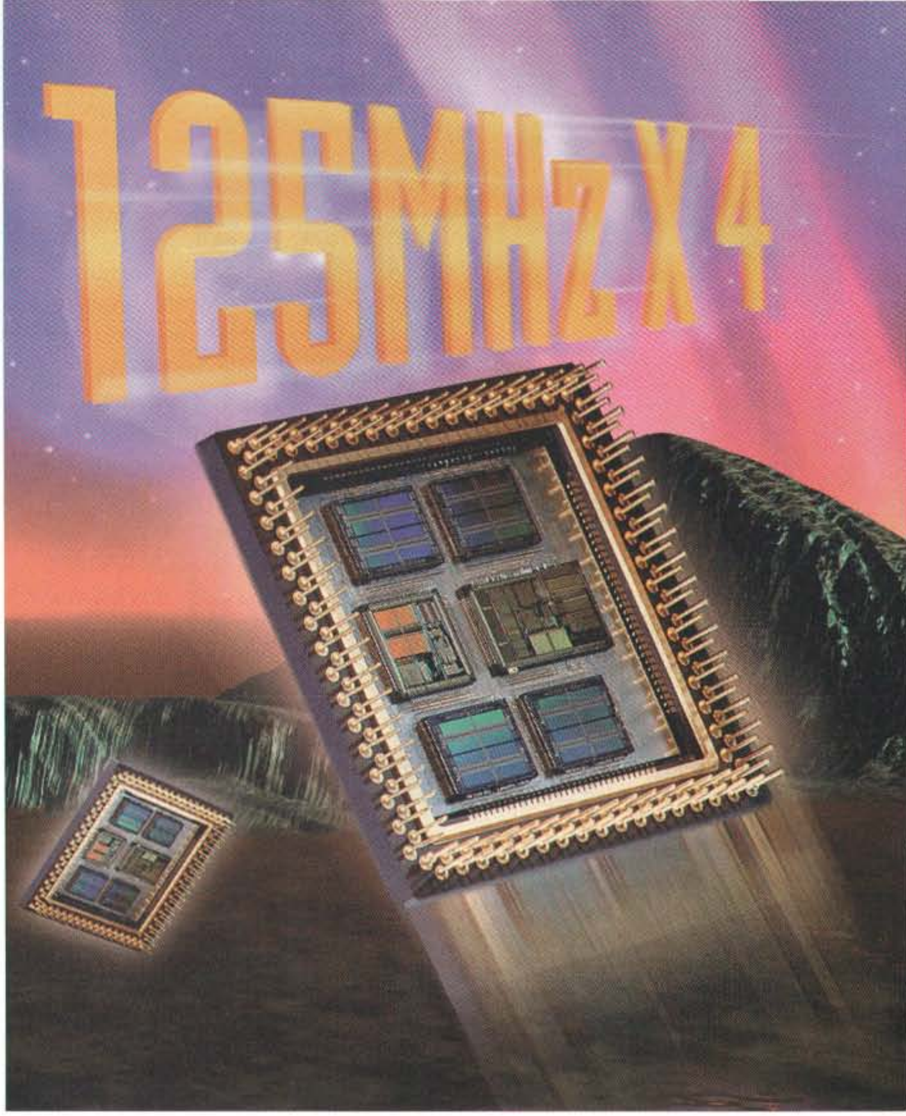
WHEN IT COMES TO YOUR COMPANY'S WORKSTATIONS, SPEED IS MONEY!



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MIPS 175 MHz	130	100
Alpha 166 MHz	108	135
superSPARC 75 MHz	126	121
microSPARC-II 110 MHz	75	65

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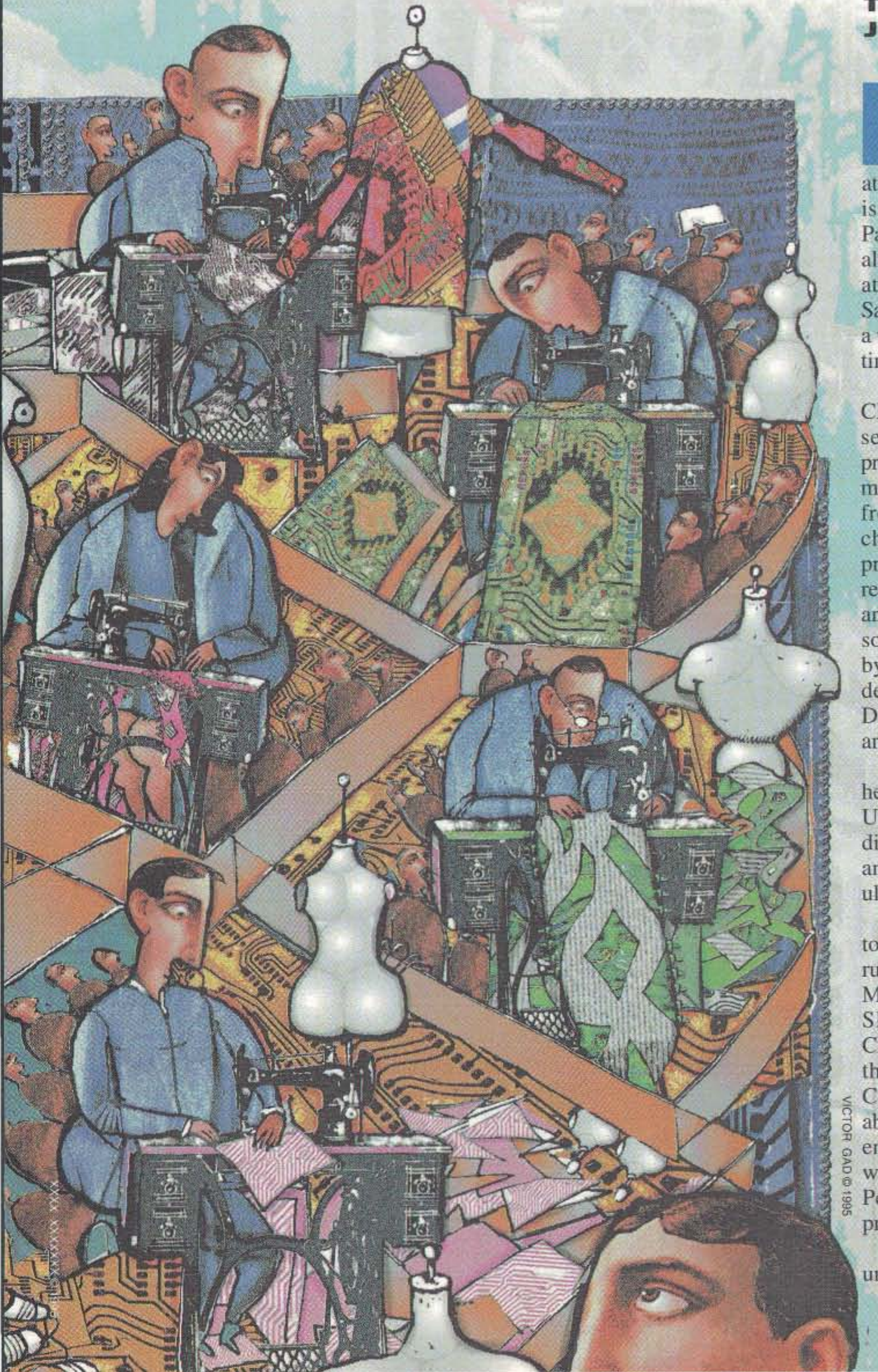
CHIP FASHION

Multimedia chips will dominate the technical talk at this year's Microprocessor Forum



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TOM R. HALFHILL AND JOHN MONTGOMERY

In 1996, skirts will be longer, suits will be double-breasted, and chips will go multimedia. The latter is the big news at this year's Microprocessor Forum. This is the high-tech equivalent of the annual Paris fashion shows. At last year's forum, all the excitement surrounded next-generation CPUs. But at this year's forum in San Jose, California, the focus is moving to a wave of specialized microprocessors optimized for multimedia.

Some will replace general-purpose CPUs in vertical applications, such as TV set-top boxes. Others will work as coprocessors alongside conventional CPUs in mainstream PCs. They all share a departure from the generalized computational architecture that typifies today's microprocessors. To deal more efficiently with real-time digitized streams of analog audio and video, these innovative microprocessors are adopting some techniques used by digital signal processors (DSPs). Indeed, they often resemble hybrid CPU/DSPs that blend CISC, RISC, and DSP architectures in fascinating ways.

The four multimedia chips expected to heat up this year's forum are the MicroUnity Mediaprocessor, the Philips Trimedia, the Chromatic Mpact Media Engine, and the Nvidia NV1. They're all scheduled to appear in products in 1996.

General-purpose CPUs are also adapting to the demands of multimedia, and the forum will highlight those chips as well. Sun Microsystems is announcing the UltraSPARC-II, an enhanced version of its CPU, with special multimedia instructions, that was unveiled at last year's forum. Cyrix is expected to release some details about its Multimedia 586, which is apparently an M1 variant. Intel is known to be working on a multimedia version of the Pentium (code-named P55C), though it probably won't be presented this year.

Clearly, a new trend in chip design is under way. As PCs move beyond simple numbers and words to richer, more complex data types, the old approach to number crunching is no longer adequate. Over the next decade, we'll see a new generation of PCs that are as adept at handling audio and video as today's computers are at running word processors and spreadsheets.

MicroUnity Mediaprocessor

MicroUnity has been working in great secrecy on a new chip set that is supposed to revolutionize multimedia and broadband communications. What hath MicroUnity wrought? Only time will tell if it's a breakthrough, but its technical underpinnings are fascinating. MicroUnity has created a three-part chip set that streamlines the links among broadband interactive networks (e.g., coaxial cable, fiber optics, and wireless) and client devices.

The client device could be a next-generation set-top box, where MicroUnity's chip set might replace a general-purpose CPU and half a dozen ASICs. Or it could be a communications device, such as a cable modem or an asynchronous transfer mode (ATM) switch, where the chip set might replace an embedded processor, a DSP, and various support chips. The MicroUnity chip set could also be integrated onto the motherboard of a multimedia PC, if it can weather the economics of today's low-margin clone market.

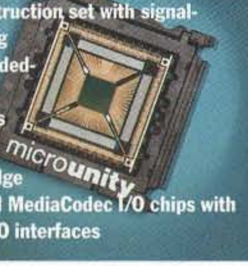
Central to the MicroUnity chip set is the Mediaprocessor, which is a programmable microprocessor that combines CISC, RISC, and DSP techniques with a high-bandwidth architecture. The actual interface to the broadband network is provided by the MediaCodec, an A/D converter (ADC) that boasts an impressive set of communications functions. Rounding out the trio is the MediaBridge, an external cache that can interface to a Peripheral Component Interconnect (PCI) bus and main-memory DRAM. The MediaCodec and MediaBridge are optional.

By far the most interesting chip is the Mediaprocessor, which is capable of prodigious throughput. MicroUnity is fabricating a "slow" 300-MHz version of the chip on a 0.6-micron CMOS process. The fast version, built on 0.5-micron BiCMOS, runs at 1 GHz (i.e., 1000 MHz). Thanks to a proprietary process technology invented by MicroUnity (which has built a chip foundry), the 1-GHz version squeezes about 10 million transistors onto a die only 10 millimeters square. It achieves these tiny dimensions by using four interconnected layers of ultraplanar metal, which is also part of the secret behind the Mediaprocessor's blazing speed. The critical paths are extremely short.

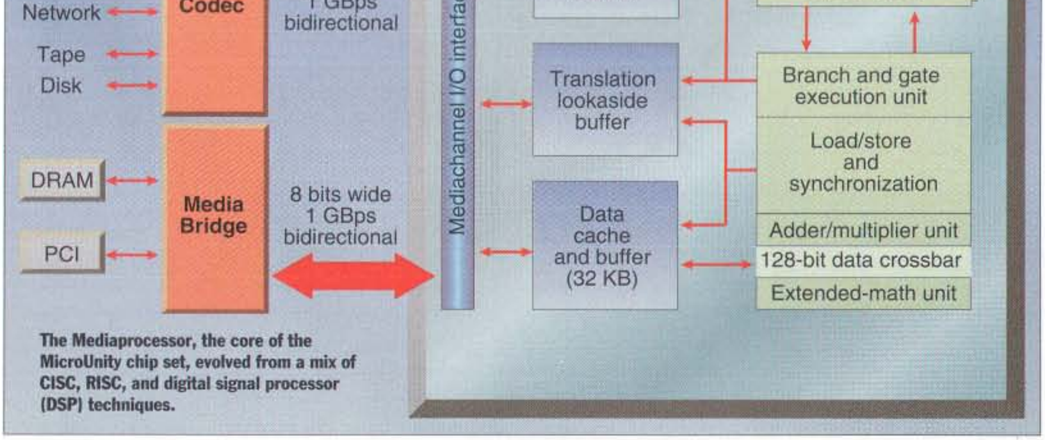
The other reason for the Mediaprocessor's high performance is a unique architecture. It's a five-cylinder multithreaded microprocessor. It can handle five tasks at once, devoting 200 MHz of processing bandwidth to each task. To do this, it maintains five files of 64-bit registers, with 64 registers per file. It also has 64 KB of onboard cache memory, equally divided between instructions and data. A dedicated I/O bus that's only 8 bits wide but can transfer 1 GB of data per second connects the Mediaprocessor to the MediaCodec and MediaBridge.

MICROUNITY MEDIAPROCESSOR

- **Optimized for multimedia and broadband communications**
- **Clock speeds from 300 MHz to 1 GHz**
- **32-bit instruction set with signal-processing and extended-math operations**
- **Optional MediaBridge cache and MediaCodec I/O chips with 1-GBps I/O interfaces**



The Mediaprocessor has a dense instruction set that includes special operations for signal processing and extended math. For example, one of the instructions is called group fixed-point multiply and add. In a single cycle, this lone instruction can multiply four 32-bit operands by four other 32-bit operands, add the results to four more 32-bit operands, and return four 32-bit final results. That's 512 bits of bandwidth per clock cycle: 384 bits of input and 128 bits of output.


MicroUnity Building Blocks
Mediaprocessor
Audio
Video
Radio
Network
Tape
Disk
DRAM
PCI
Media Codec
Media Bridge
8 bits wide 1 GBps bidirectional
8 bits wide 1 GBps bidirectional
Mediachannel I/O interface
Instruction cache and buffer (32 KB)
Translation lookaside buffer
Data cache and buffer (32 KB)
Register files (5) 64 registers per file 64 bits wide
Branch and gate execution unit
Load/store and synchronization
Adder/multiplier unit
128-bit data crossbar
Extended-math unit

The Mediaprocessor, the core of the MicroUnity chip set, evolved from a mix of CISC, RISC, and digital signal processor (DSP) techniques.

The Mediaprocessor is fully programmable and can run its own real-time OS or other low-level real-time OSes. It can even run a higher-level OS such as Unix. Thus, it doesn't need a regular CPU for vertical solutions (e.g., set-top boxes). MicroUnity expected to announce products that will use its chip set in October.

Philips Trimedia

If you think of small talking heads in postage-stamp-size windows when you think of PC video, Philips may have a surprise for you. The Trimedia microprocessor is capable of taking over for your video and sound cards and generating multiple, independently scaled live video windows that overlap in any way you want.

The Trimedia is a general-purpose microprocessor that

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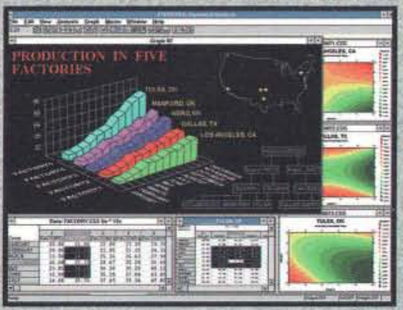
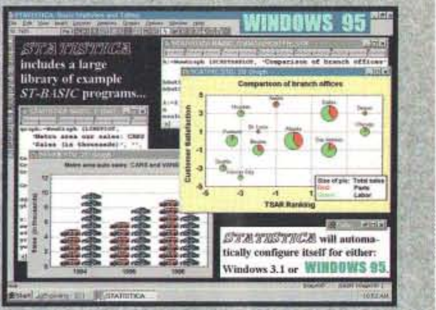
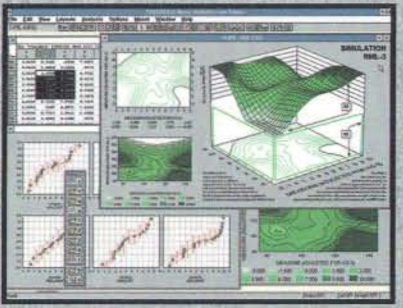
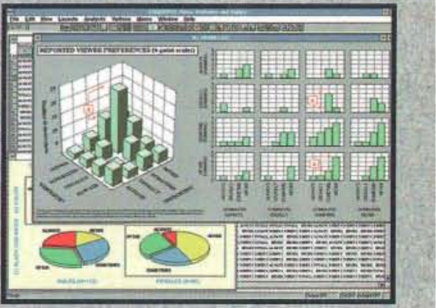


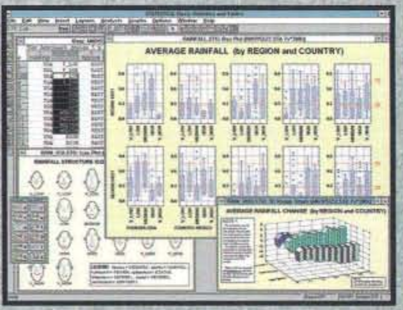


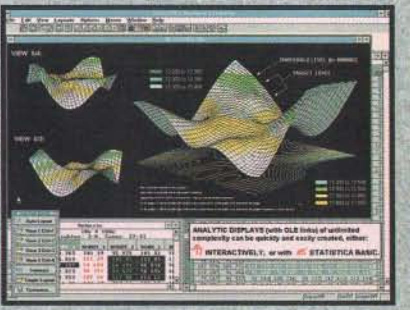
STATISTICA includes a large library of example *ST-BASIC* programs...

STATISTICA will automatically configure itself for either: Windows 3.1 or WINDOWS 95.

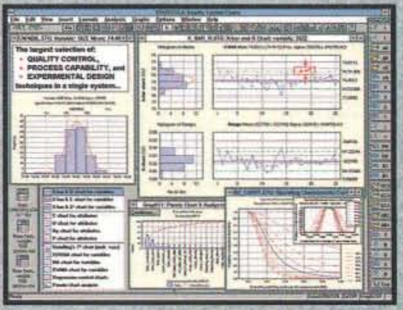








ANALYTIC DISPLAYS (with OLE links) of unlimited complexity can be quickly and easily created, either: INTERACTIVELY, or with STATISTICA BASIC.



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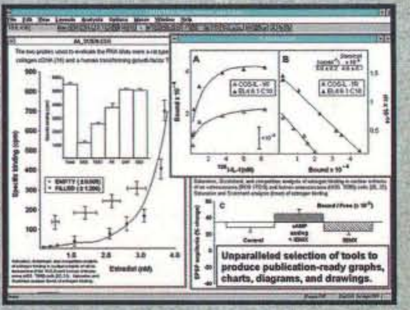

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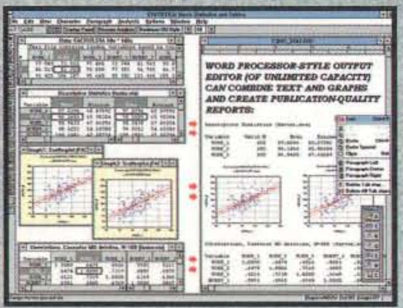

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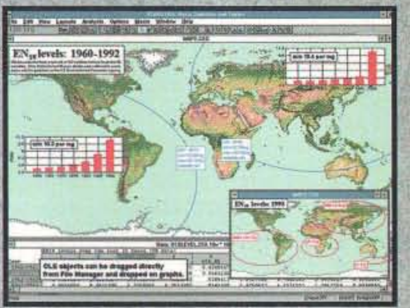


OLE objects can be dragged directly from File Manager and dropped on graphs.

Circle 97 on Inquiry Card.

has been enhanced to boost multimedia performance. It's a cross between a CPU and a DSP. When the Trimedia is placed in a typical PC, it will act as a multimedia coprocessor. Its role as a general-purpose microprocessor will be realized only when it's used in such devices as set-top boxes.

At the center of it is a 400-MBps bus that connects autonomous modules, including video in, video out, audio in, audio out, an MPEG variable-length decoder (VLD), an image coprocessor, a communications block, and a very long instruction word (VLIW) processor.

The VLIW processor includes a rich instruction set, with many extensions for handling multimedia. It is capable of sustaining five RISC operations per clock cycle at 100 MHz. Philips gets this performance by incorporating 27 functional units in the VLIW engine and feeding them with five instruction-issue registers. The functional units include multiple-integer ALUs, a multiple floating-point ALU, several integer and floating-point multipliers, and DSP attachment units. The functional units are pipelined, ranging from one deep (the integer ALU) to three deep (the floating-point ALU). Pipelines are also redundant (e.g., there is more than one add unit). With this design, the only functional unit that can't be fed on every clock cycle is the floating-point square root/divide.

PHILIPS TRIMEDIA

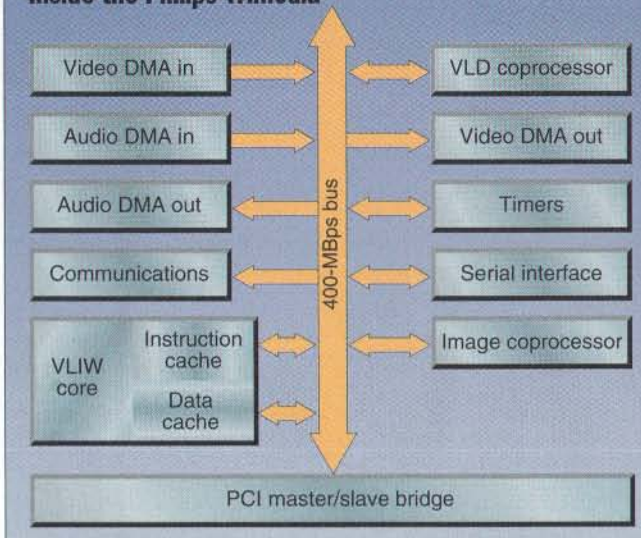
- DMA mastering-video and audio-I/O units
- MPEG-2 VLD that also supports MPEG-1
- Interfaces to PCI bus, digital cameras, and stereo audio
- Low cost (under $50)

The VLIW engine also includes 48 KB of cache memory: 32 KB for instructions and 16 KB for data. To save bandwidth and storage space, the VLIW instructions are compressed until the VLIW core needs them—even the instruction cache stores them compressed.

The other modules are processors that are each responsible for handling data-specific functions. These are generally functions that prepare data for the VLIW core.

The Trimedia is tuned to enable multiple modules to prepare their data simultaneously. The key to this is DMA. The VLIW core can issue a single instruction that opens a DMA path between main memory (stored off the chip) and any of the modules. With two instructions, video and audio could start streaming into the Trimedia. The video in and audio in modules would then asynchronously prepare the data for whatever future it may have.

Inside the Philips Trimedia



The Trimedia looks a lot like a CPU and a lot like a digital signal processor (DSP). The chip is designed so that the very long instruction word (VLIW) core has to do few extraneous calculations, leaving those to dedicated coprocessors.

The Trimedia uses "glueless" interfaces to the PCI bus, a digital camera, a video encoder, a stereo audio ADC/DAC, and a V.34 modem analog front end or ISDN terminal interface. The glueless interfaces decrease the cost of installing the Trimedia in a system—by up to one-third—by eliminating the need for separate adapters. The chip will cost below $50 in quantity.

With its low price and high performance (Philips estimates it will be able to perform 2 to 4 billion operations per second [BOPS] at 100 MHz), the Trimedia has the potential to become a standard part of PCs and consumer electronics devices. Philips, however, was reluctant to disclose its partners at press time.

Mpact Media Engine

The Mpact Media Engine, which is from Chromatic Research, is architecturally similar to a general-purpose DSP. However, it's actually a highly specialized microprocessor that's designed to bring a wealth of multimedia features to mass-market x86-compatible PCs. When integrated on a PC motherboard, the Mpact can do the jobs of a Windows graphics accelerator, a 3-D graphics coprocessor, an MPEG video encoder/decoder, a sound card, a fax modem, and a telephony card. It should cost system vendors less than $150 and should be in PCs by mid-1996.

Internally, the Mpact is a 1.4-million-transistor specific-purpose processor, not just a gate array or a standard-cell amalgam of other chips. It has five ALUs, including one dedicated to motion estimation—a critical function for video encoding and videoconferencing. The parallel ALUs tie into an enormous 792-bit-wide crossbar bus that can move up to 8 billion integers per second between the ALUs and the chip's primary cache. The cache has eight ports and 4 KB of static RAM (SRAM), and it's connected over a 500-MBps bus to an off-chip secondary cache that has 2 to 4 MB of Rambus DRAM (RDRAM).

According to Chromatic, this architecture (which is reminiscent of the Texas Instruments MVP DSP) can sustain 1 to 2 BOPS for most multimedia functions. Its peak rate when performing motion-estimation functions is an incredible 20 BOPS.

Much of this speed is made possible by the Mpact's dense instruction stream and DSP-like optimizations. The Mpact processor has its own machine language that packs two op codes into every word by

MPACT MEDIA ENGINE

- MPEG-1 real-time video and audio encoding/decoding
- MPEG-2 video and audio decoding
- Wave-table and wave-guide sound synthesis
- H.320 (ISDN) and H.324 (analog phone line) videoconferencing

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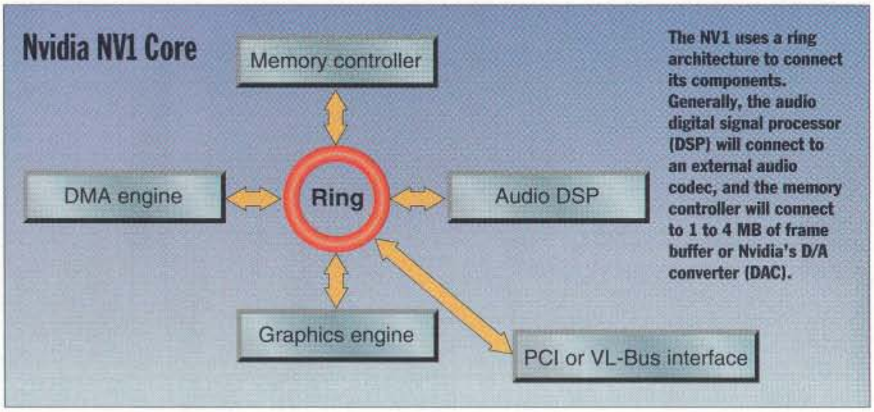

The NV1 uses a ring architecture to connect its components. Generally, the audio digital signal processor (DSP) will connect to an external audio codec, and the memory controller will connect to 1 to 4 MB of frame buffer or Nvidia's D/A converter (DAC).

using a long instruction word (LIW) format. The op codes are single-instruction multiple-data operations that can perform vector functions on arrays of operands without time-consuming program loops.

This programmability is crucial to the Mpact's versatility. Multimedia algorithms written in the Mpact's machine language will run atop the chip's own real-time OS. Device drivers running under the system OS—such as virtual device drivers (VxDs) in Windows 95—map high-level API calls to these low-level programs, which are called *mediaware modules*. Thus, users can adapt their PCs to new industry standards and improved algorithms merely by upgrading the Mpact's device drivers and mediaware modules.

Nvidia NV1

Nvidia wants your games. The NV1 is a highly integrated multimedia accelerator that includes a 3-D video accelerator (which can do 2-D graphics, too), a 350-MIPS audio engine (with Sound Blaster emulation), and an I/O processor (for joysticks and the like). This chip is designed to improve the game experience significantly. If early demonstrations are any indicator, it will.

The 3-D video accelerator is the most interesting part of the chip. What's intriguing is a graphics primitive called QTM (Quadratic Texture Map), a derivative of an algorithm named nonuniform rational B-splines (NURBS).

Here's why. Computers are good at generating straight lines, but curves present a problem. Most 3-D accelerators represent curves by interlocking polygons—polygons that consist of three or more vertices connected by straight lines. To make a curve smooth, a 3-D accelerator must use lots of small polygons, and that's compute-intensive.

The NV1 is more clever than that. Put simply, it curves the sides of its polygons, so it doesn't need as many to make curves smooth. Fewer polygons mean fewer calculations and faster 3-D acceleration. The NV1 picks up extra speed by decreasing the number of control points required by the host CPU to move through 3-D space. Its resolution is something more like plus or minus 1 pixel. In short, it's great for games with fast 3-D motion.

The audio subsystem is similarly game-oriented. It can generate 32 concurrent audio channels of CD-quality (i.e., 16-bit) audio with phase shifting (for 3-D sound). Perfect for monsters breathing, guns firing, and a great sound track. The secret of the audio subsystem is its DMA engine. The NV1 can push and pull data from main memory incredibly quickly over its preferred PCI or VL-Bus interface. Thus, it doesn't need on-board memory to hold wave sounds—it can store them in main memory. The one potential problem with the NV1's DSP is that its algorithms are hard-wired into its silicon, so upgrades could be difficult. It's a gamble that reduces the cost and size of the NV1 overall.

Everything's connected with a 32-bit unidirectional ring bus. The bus's controller accepts transaction requests and sends instructions to every component.

The main problem we see with the NV1 is its lack of MPEG-1 decoding. MPEG-1 is popular with games. A secondary problem has to do with the new game APIs in Windows 95: They aren't optimized to the

NVIDIA NV1

- Wave-table sound synthesis
- MIDI
- 3-D graphics acceleration
- Up to 32 16-bit audio channels

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NV1's 3-D texture map, so games written to these APIs won't exploit the NV1. With a volume price of $70, we'll probably see many multimedia boards built on this chip, so maybe the API problem will work itself out. Already, Sega has worked out a deal to port many of its games to the NV1, and Diamond has developed a board that uses the NV1.

Lights, Camera, Action

These aren't the only multimedia chips around—they're not even the only ones at the Microprocessor Forum this year. Hewlett-Packard's PA7300LC has multimedia instructions, for example, and Motorola and IBM are announcing new versions of their venerable DSPs.

Product Information

Mediaprocessor . . . . .not announced
MicroUnity Systems
Engineering, Inc.
Sunnyvale, CA
(408) 734-8100
fax: (408) 734-8141
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Mpact Media Engine . . . .under $150
Chromatic Research
Mountain View, CA
(415) 254-1600
fax: (415) 254-5849
info@mpact.com
Circle 1243 on Inquiry Card.

NV1 . . . .$70
Nvidia
Sunnyvale, CA
(408) 720-6100
fax: (408) 720-6111
Circle 1244 on Inquiry Card.

Trimedia . . . . .under $50
Philips Semiconductors
Trimedia Product Group
Sunnyvale, CA
(800) 234-7381
(408) 991-2000
fax: (408) 991-2311
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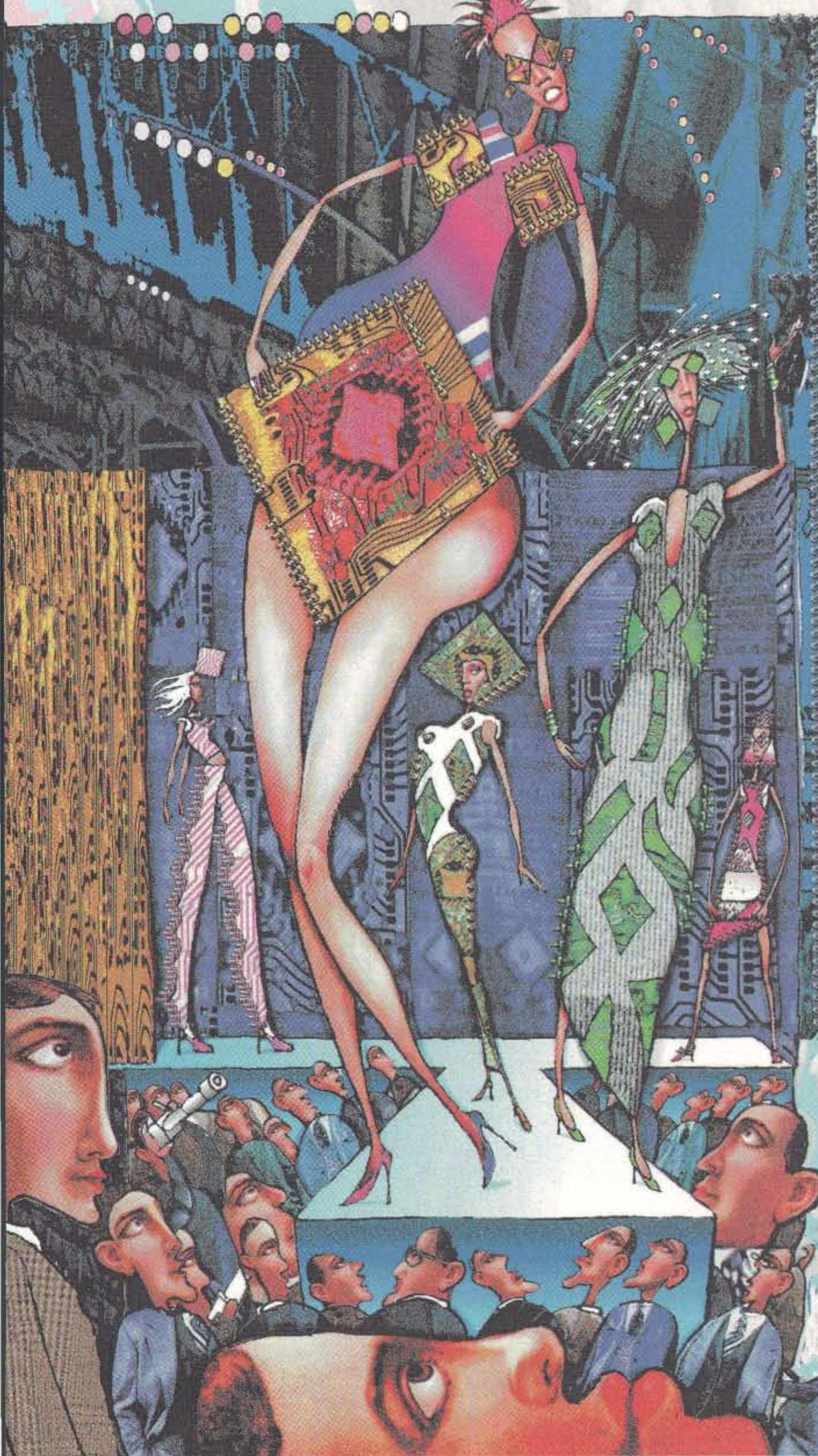
But these chips do show that microprocessor developers are reconsidering what a microprocessor is and how it should function. More important, they show a trend toward consumerization: These multimedia processors are inexpensive and small, and they consume little power. You'll be seeing them not only in your PC, but in your set-top box, your TV, and probably devices we haven't even thought of yet. ■

The guardians of BYTE's San Mateo office, Tom R. Halfhill is a senior editor, and John Montgomery is the features editor. They can be reached on the Internet or BIX at thalfhill @bix.com and jmontgomery@bix.com.

CPU SCORECARDS



VICTOR GAD © 1995

A look at how tomorrow's next-generation chips stack up

DICK POUNTAIN AND TOM R. HALFHILL

CPU choices used to be clean when the great rivals, CISC and RISC, were in two distinct camps. But with the CPU introductions set to begin late this year, each camp steals the other's best ideas, and blurs replace distinctions.

For example, Intel's P6 translates long x86 CISC instructions into simple, fixed-length micro-operations executed by what is essentially a RISC processor core. Sun Microsystems' UltraSparc-II will boast special graphics instructions to speed up the MPEG decoding that would require up to 48 instructions on other processors. These are CISC instructions in all but name.

The scorecards on the following pages show that next-generation CISC and RISC CPUs will fight performance battles on four fronts: executing more instructions per cycle, executing instructions out of order to sidestep dependencies, renaming registers to avoid register famine, and contributing to faster overall system performance, not just CPU speed.

All these chips issue more than one instruction per cycle; the five RISC CPUs here are all four-issue superscalar designs. But they vary in the number of function units they provide, ranging from nine in the UltraSparc to four in the Alpha 21164.

Processes are shrinking, too. Intel, Digital, and Mips will all deliver 0.35-micron chips by early 1996. By 1997, expect to see CPUs built in 0.25-micron CMOS, clocked at 400 MHz, and delivering 1000 SPECfp95. It's also reasonable to expect that by then software designers will have found a way to soak up all that power and redraw the battle lines.

Dick Pountain is a BYTE contributing editor based in London. Tom R. Halfhill is a BYTE senior editor based in San Mateo, California. You can reach them on the Internet or BIX at dickp@bix.com and thalfhill@bix.com, respectively.

CURRENT STATUS: Entering production

LIKELIHOOD INTRODUCTION DATE WILL BE MET: Good

TARGET CLOCK SPEED: 150 MHz

ESTIMATED PERFORMANCE:
220 SPECint92; 215 SPECfp92

FABRICATION PROCESS/FEATURE SIZE:
BiCMOS/0.6-micron

TECHNOLOGICAL ADVANTAGES:
A multichip package with a 256-KB secondary cache coupled to the CPU at full core speed; out-of-order superscalar microarchitecture; chip is superpipelined for high clock speeds.

TECHNOLOGICAL DISADVANTAGES:
The multichip package is costly to manufacture; the microarchitecture is tuned for 32-bit software, yielding poor performance with 16-bit code; power consumption and heat dissipation are currently unsuitable for notebook computers.

PRIMARY MARKET: Servers and high-end PCs.

WHERE TO FIND: Intel, Santa Clara, CA, (800) 628-8686 ext. 134 or (408) 765-8080; fax (800) 628-2283 (documents 7162 through 7165); http://www.intel.com/.

INTEL

Next generation: **P6**

DOSSIER: The first PCs containing Intel's sixth-generation P6 processor should appear late this year. Intel originally planned to introduce the P6 at 133 MHz, but thanks to better-than-expected performance from the initial silicon, Intel now hopes to debut the chip at 150 MHz. Some speed-sorted parts may reach 166 MHz.

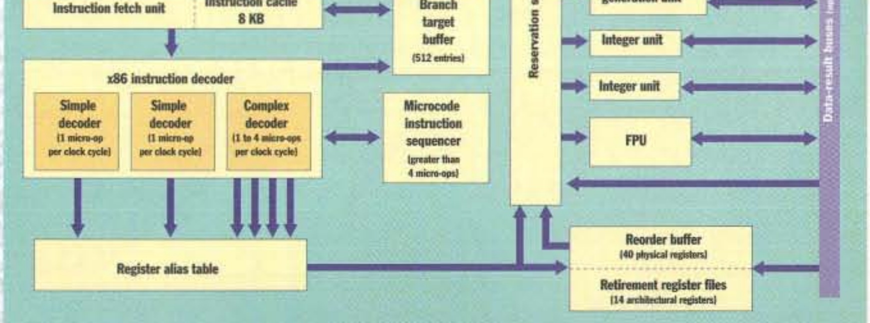
Even faster clock speeds are coming soon, and Intel designed the superpipelined P6 to handle them. In 1996, the P6 will begin migrating from Intel's 0.6-micron BiCMOS process to a smaller, faster, 0.35-micron BiCMOS process technology. (High-end Pentiums are already fabricated on this process.) The optical shrink could allow Intel's flagship processor to hit 231 MHz by the end of next year.

The P6 has a dark side, however. It runs 16-bit software slower than a Pentium does. Intel optimized the P6 for 32-bit code, making compromises that severely impair its performance with older, 16-bit code. As a result, even a Pentium that runs at a slower clock speed than a P6 will do a better job with most of today's mainstream software. (See News & Views, September and October BYTE.)

Competitors are ecstatic about this, but Intel is keeping a stiff upper lip. By around 1997, the P6's price should drop low enough to make it a mainstream processor, and 32-bit OSes and applications should be commonplace.

Meanwhile, the Pentium will continue to dominate the market for x86 CPUs. Late this year, Intel will introduce a 150-MHz Pentium, to be followed by faster versions in 1996. The 0.35-micron process technology should allow future Pentiums to run at 167 to 180 MHz, and perhaps 200 MHz. These advances at the high end will pull the entire market forward. Today, standard Pentiums run at 75 to 100 MHz; by this time next year, the midpoint will probably be 120 MHz.

P6 Plumbing



The P6 is superpipelined for fast clock speeds, starting at 150 MHz.

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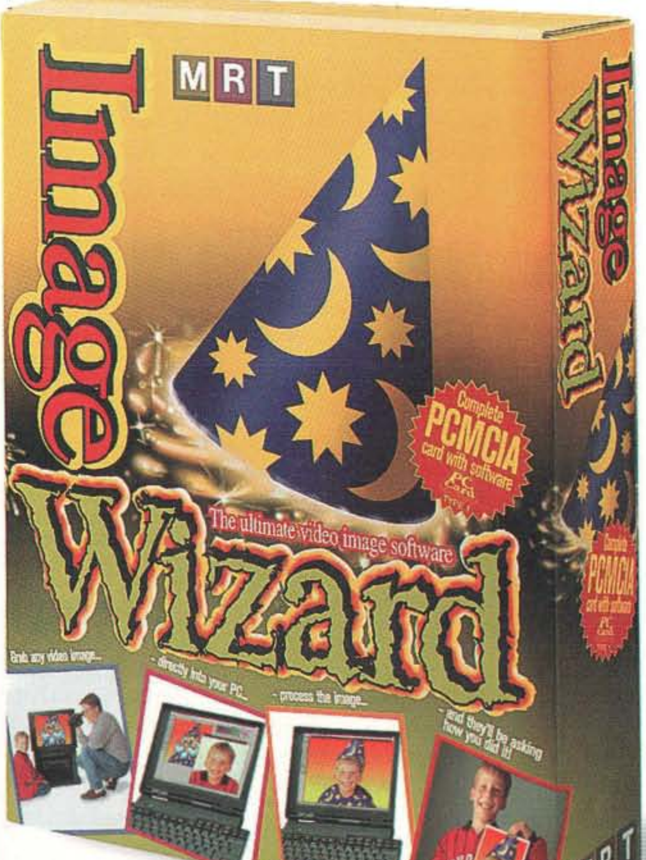
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Official introduction date:
Fourth quarter of 1995

CURRENT STATUS: Taped out (i.e., design completed)

LIKELIHOOD INTRODUCTION DATE WILL BE MET: Fair

TARGET CLOCK SPEED: 120 MHz

ESTIMATED PERFORMANCE: 176 to 203 SPECint92

FABRICATION PROCESS/FEATURE SIZE: CMOS five-layer metal/0.6-micron

TECHNOLOGICAL ADVANTAGES: Performance is estimated to be equal to or better than that of the Pentium-150, with a 50 percent smaller die than the original 6x86-100.

TECHNOLOGICAL DISADVANTAGES: Die size is still relatively large compared to that of the latest Pentiums.

PRIMARY MARKET: Mainstream PCs.

WHERE TO FIND: Cyrix, Richardson, TX, (214) 968-8388; fax (214) 699-9857; http://www.cyrix.com.

CYRIX

Next generation: **M1rx**

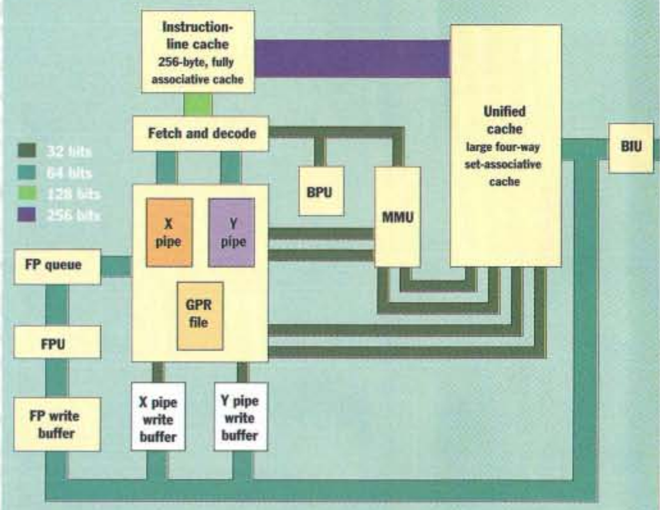
DOSSIER: Cyrix's first M1 chip, the 6x86-100, is crippled by a monstrously large die that's difficult and expensive to manufacture. The M1rx (a code name) addresses that problem by using five layers of metal instead of three on the same 0.6-micron process, which reduces the die from 394 square millimeters to approximately 225 mm^2. This also allows Cyrix to boost the internal clock speed to 120 MHz.

Cyrix is ramping up production of both the 6x86-100 and the M1rx-120 late this year, but don't expect to see high volumes of either chip until 1996. In fact, nobody will be surprised if the large-die 6x86-100 *never* attains high volumes; it's so costly it will probably be discontinued after a relatively short product life.

In the first quarter of 1996, Cyrix plans to optically shrink the 6x86 to a 0.5-micron, five-layer-metal process that will reduce production costs still further and increase the clock speed to 133 MHz. That version should match or exceed the performance of a 167-MHz Pentium. In the third or fourth quarter of 1996, Cyrix promises that the 6x86 will reach 150 MHz. The estimated performance would exceed that of a 180-MHz Pentium.

If Cyrix is able to meet these goals, the company will likely sell all the CPUs it can make. Clock for clock, the 6x86 beats the Pentium and is competitive with Intel's P6. Indeed, the 6x86 should easily outperform the P6 when running the 16-bit and mixed 16-/32-bit code that dominates the PC market today.

The M1rx Foundation



The M1rx will shrink Cyrix's 6x86 design down to a more manageable die size.

Meanwhile, Cyrix isn't ignoring entry-level PCs. Although the company is phasing out 486 production late this year, it's filling the gap with the 5x86, a hybrid design that adopts some of the 6x86's features in a chip that's initially pin-compatible with 32-bit 486 sockets (see "New 486 Chips Deliver Inexpensive Power," September BYTE). The low-power 5x86 is also ideal for notebook computers.

Although Cyrix has had trouble getting the 6x86 into production, the company now appears well-positioned to take advantage of the explosive growth in the PC market. The P6's poor performance with 16-bit code is a lucky break for Cyrix, because the 6x86 will be a better choice for the millions of people using Windows 3.1 and Windows 95.

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CURRENT STATUS: Sampling

LIKELIHOOD INTRODUCTION DATE WILL BE MET: Good

TARGET CLOCK SPEED: 75 MHz

ESTIMATED PERFORMANCE: 109 to 115 SPECint92

FABRICATION PROCESS/FEATURE SIZE:
CMOS three-layer metal/0.35-micron

TECHNOLOGICAL ADVANTAGES:
Four-way superscalar microarchitecture; decoupled RISC-like core; speculative, out-of-order execution.

TECHNOLOGICAL DISADVANTAGES:
Clock speeds are falling short of initial targets; lengthy compatibility testing has delayed introduction.

PRIMARY MARKET: Mainstream desktop PCs.

WHERE TO FIND:
AMD, Austin, TX, (800) 222-9323 or (408) 749-5703; http://www.amd.com.

AMD

Next generation: **K5**

DOSSIER: AMD's reputation is riding heavily on the K5, the company's first x86 processor to break free of Intel's designs. The birth of the K5, however, has not been without labor pains.

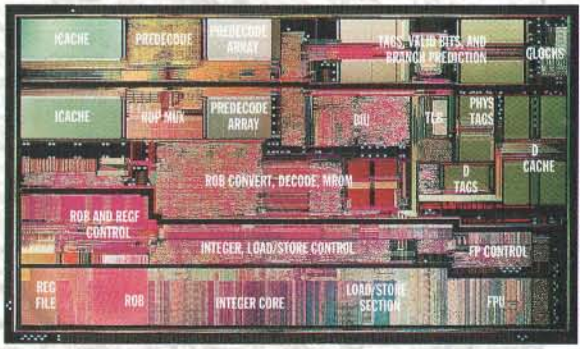
Originally, AMD planned to ship the K5 in volume this year at clock speeds ranging from 100 to 120 MHz. Instead, only a few thousand K5 chips will trickle out of AMD's foundries in the fourth quarter, and they will be clocked at a conservative 75 MHz.

What happened? AMD apparently underestimated how long it would take to verify the K5 (especially after the public furor over the Pentium bug), and the company was overoptimistic about the K5's initial silicon. Missed deadlines and slower clock speeds resulted.

But AMD is working hard to catch up. Few, if any, of the K5 chips manufactured this year on AMD's 0.5-micron process will show up in commercially available systems. In the first quarter of 1996, AMD plans to move the K5 onto its new 0.35-micron process technology, which was developed in partnership with HP and is centered in AMD's brand-new Fab 25 in Austin, Texas. That will shrink the K5's 4.2-million-transistor die to about 167 mm^2 and allow significantly higher yields. It will also permit faster clock speeds.

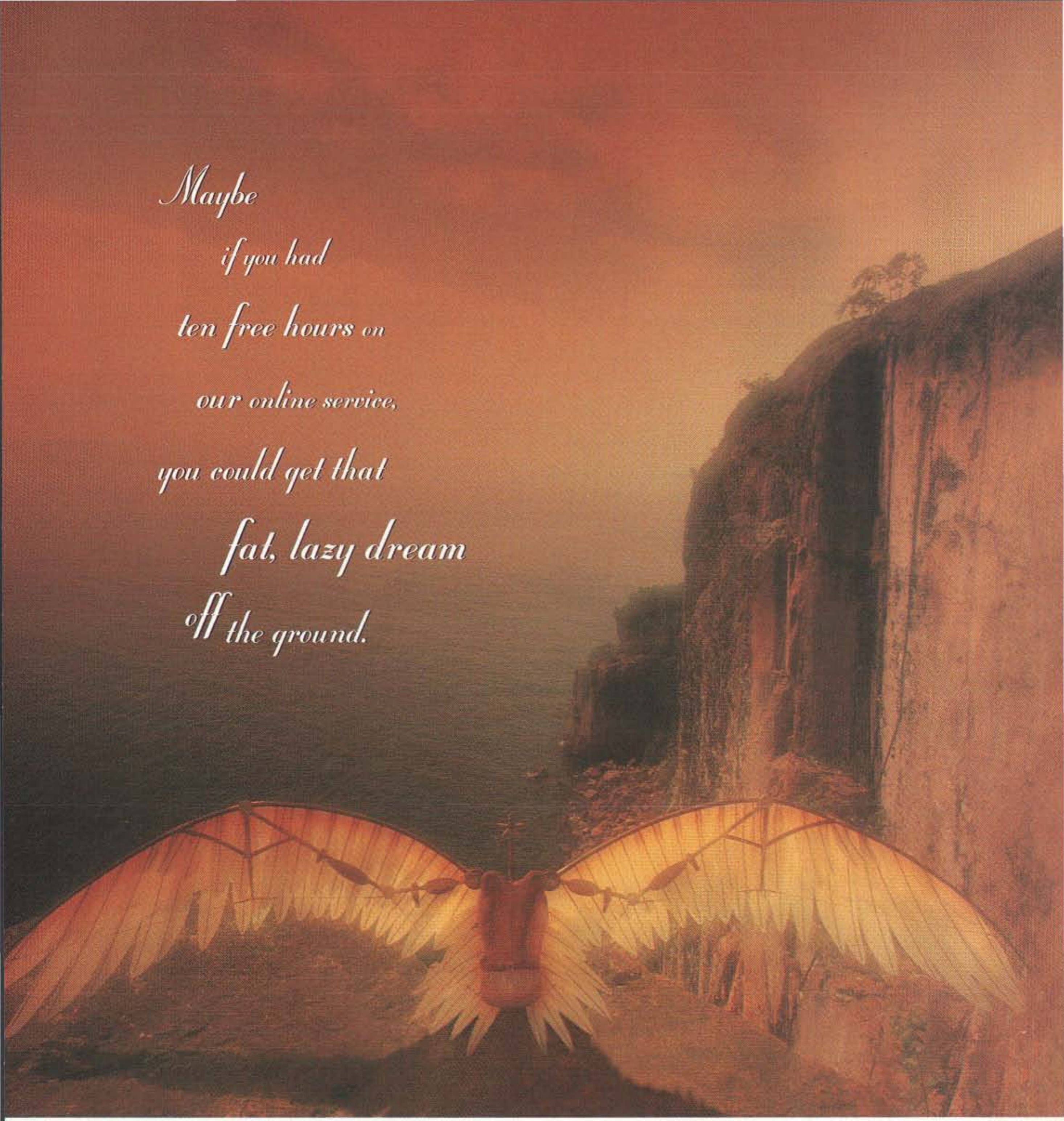
AMD says its production will ramp up rapidly in 1996, enough for it to ship more than 5 million K5s by the end of next year. According to AMD, clock speeds will rise to 90 or 100 MHz in the first quarter and go beyond 100 MHz after that. AMD hasn't released official SPEC numbers or allowed independent benchmarking, but based on the claim that the K5 is 30 percent faster than a Pentium at the same clock speed, we estimate the performance of a 75-MHz K5 at 109 to 115 SPECint92. That should scale to about 150 SPECint92 at 100 MHz.

Even if AMD succeeds in meeting these goals, the K5 will trail high-end Pentiums in raw performance—and then there's the P6. AMD's answer to Intel's sixth-generation CPU is supposed to be the K6, but that's highly unlikely to happen before 1997. Nevertheless, AMD should have no trouble selling all the chips that it can make next year. In addition, the company is putting itself into a better position for the future; it recently purchased a second Quickturn simulator to accelerate its compatibility testing.



A look at the AMD K5's superscalar architecture.

Meanwhile, AMD will keep its foundries busy by cranking out 486 chips for a declining but worthwhile market. Worldwide 486 shipments are expected to drop from 35 million this year to 20 million in 1996, and AMD hopes to ship most of those. AMD's souped-up 486 chips, clocked at 120 and 133 MHz, will compete with low-end Pentiums in entry-level PCs (see "New 486 Chips Deliver Inexpensive Power," September BYTE). However, the pressure is on AMD to ramp up the K5, because the 486 is quickly dropping off the map.



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Official introduction date: Unknown (second half of 1996?)

CURRENT STATUS: Design stage

LIKELIHOOD INTRODUCTION DATE WILL BE MET: Fair

TARGET CLOCK SPEED: Unknown

ESTIMATED PERFORMANCE: Unknown; probably comparable to that of the Intel P6.

FABRICATION PROCESS/FEATURE SIZE: CMOS/0.35- or 0.25-micron

TECHNOLOGICAL ADVANTAGES: The Nx686 will enhance the decoupled RISC-like microarchitecture first introduced in the Nx586 while retaining the Nx586's high-speed dedicated cache interface.

TECHNOLOGICAL DISADVANTAGES: The Nx686 could reveal the future limits of increased parallelism in a decoupled core.

PRIMARY MARKET: Mainstream desktop PCs.

WHERE TO FIND: NexGen, Inc., Milpitas, CA, (800) 863-9436 or (408) 435-0202; http://www.nexgen.com.

NEXGEN

Next generation: **Nx686**

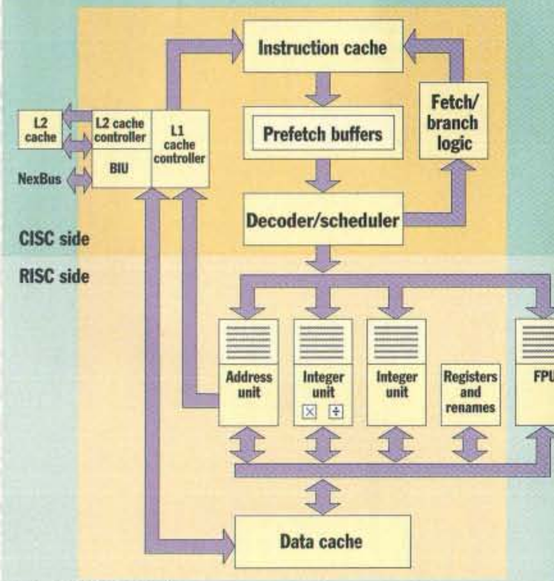
DOSSIER: Little is known about the Nx686, because the chip hasn't been announced yet and NexGen doesn't want to tip its hand to rivals AMD, Cyrix, and Intel. However, NexGen has stated that the Nx686 will match the performance of Intel's P6 and build on the microarchitecture introduced by the Nx586 in 1994.

That microarchitecture, dubbed RISC86 by NexGen, was the first of its kind to appear in an x86 processor. Similar microarchitectures have since been adopted by Intel's P6 and AMD's K5. The basic idea is to convert the troublesome CISC instructions of x86 software into RISC-like operations that execute in parallel within a RISC-like processor core. This approach, known as a *decoupled microarchitecture*, allows a CISC processor to take advantage of RISC's architectural innovations and be backward-compatibile with existing x86 software.

The Nx686 will advance this philosophy to the next logical level. Currently, the Nx586 has three execution units, a three-way superscalar core, and the ability to decode only one x86 instruction per clock. That opens up several opportunities for improvement. The Nx686 will probably have at least five execution units, four execution pipelines, and multiple decoders capable of handling two or more x86 instructions per clock. To cope with the increased complexity of this design, the Nx686 will likely add more rename registers and instruction queues.

One thing that won't change is the integrated cache controller and high-speed cache interface. The Nx686, like its predecessor, will talk to its secondary cache over a dedicated I/O bus that runs at the full speed of the processor core. Intel adopted this feature in the P6 and went even further by including a 256-KB static RAM (SRAM) cache in a multichip package. NexGen says it's considering this option because its foundry partner, IBM Microelectronics, is good at making SRAM and multichip modules (MCMs).

A Hint of Things to Come?



BIU = branch interface unit

The earlier-generation Nx586 architecture, shown here, will probably be extended in the Nx686.

An example of IBM's MCM technology can be seen in a new version of the Nx586 that's scheduled to ship this quarter and includes both a CPU and an FPU die in an MCM. At the same time, a relayout and a process shrink to 0.35 micron have made it possible for NexGen to dramatically reduce the size of the CPU die to less than 118 mm^2—the smallest in its class.

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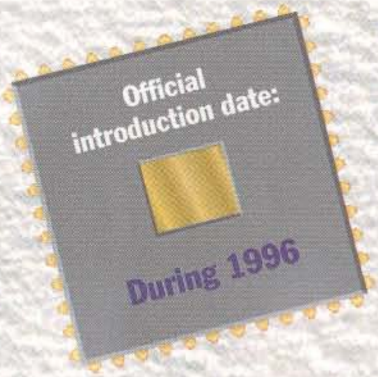


CURRENT STATUS: Sampling in first quarter of 1996

LIKELIHOOD INTRODUCTION DATE WILL BE MET: Unknown

TARGET CLOCK SPEED: Over 300 MHz

ESTIMATED PERFORMANCE:
500 SPECint92; 700 SPECfp92

FABRICATION PROCESS/FEATURE SIZE:
CMOS/0.35-micron

TECHNOLOGICAL ADVANTAGES:
The Alpha 21164A retains the microarchitecture of the 21164, a four-way superscalar design with extremely simple, stripped-down data paths that allow it to be clocked faster than other vendors' chips.

TECHNOLOGICAL DISADVANTAGES:
At around $3000, the Alpha 21164 is the most expensive RISC chip on the market, and the 21164A is likely to retain this distinction. The latest version depends more on compiler quality to achieve maximum throughput than some competitors. For optimum throughput, the chip must cluster instructions into groups of four that execute together, and this task is left entirely to the compiler.

PRIMARY MARKET: Scientific and engineering workstations and high-end Windows NT and Unix servers.

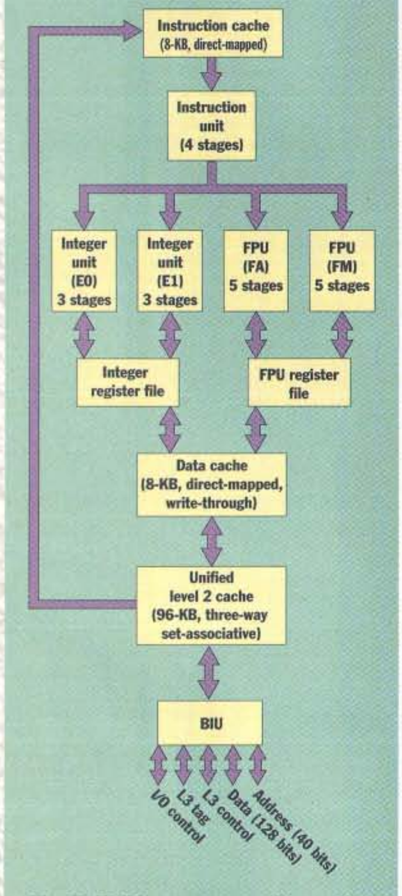
WHERE TO FIND: Digital Equipment, Hudson, MA, (800) 332-2717 or (508) 568-6868; semiconductor@digital.com.

DIGITAL EQUIPMENT

Next generation: **Alpha 21164A**

DOSSIER: The Alpha adheres more closely to the RISC philosophy than its competitors by stripping away every ounce of fat from the hardware and instruction set in favor of the fastest possible data path. Alpha designers believe that a faster clock will buy you what other chips achieve through fancy hardware. The principle appears to work: The 21164 was the fastest single-chip microprocessor in the world when it was launched in 1995, with three times the integer performance of a Pentium/100 and faster FPU performance than Mips' R8000 supercomputer chip set. The next-generation 21164A's layout has not changed, but the chip will apply a process shrink and compiler enhancements to deliver even more SPECmarks.

Inside the World's Fastest RISC CPU


Instruction cache (8-KB, direct-mapped)
Instruction unit (4 stages)
Integer unit (E0) 3 stages
Integer unit (E1) 3 stages
FPU (FA) 5 stages
FPU (FM) 5 stages
Integer register file
FPU register file
Data cache (8-KB, direct-mapped, write-through)
Unified level 2 cache (96-KB, three-way set-associative)
BIU
I/O control
L3 tag
L3 control
Data (128 bits)
Address (40 bits)

The 21164A improves upon the existing Alpha design with a process shrink and a better compiler.

The 21164 family eschews out-of-order execution, relying instead on smart compilers that can sequence code to minimize pipeline stalls. At 9.3 million transistors, these chips have the largest transistor budget of any CPUs made so far, but most of them are used for cache-memory cells. The 21164 design has relatively small (8-KB) direct-mapped primary caches, but it's the first CPU to place a large (96-KB) secondary cache actually on-chip for minimum latency. Intel's P6 has its secondary cache in the same package, but not on the same silicon slice.

The 21164 family has four execution units (two integer and two floating-point) and can issue two instructions of each kind per cycle. It has a four-stage instruction pipeline that feeds into separate integer, floating-point, and memory-execution pipelines. Compared to other next-generation RISC chips, the 21164 has pipelines that are relatively deep and simple, for high clock speeds.

The instruction pipeline doesn't do any complex checking for data dependencies or issue any instructions out of order. If the current four instructions cannot all be issued into different execution units, the instruction pipeline stalls until they can. Unlike its competitors, the 21164 doesn't use register renaming; instead, it updates architectural registers directly once a result has reached the final writeback stage of the pipeline. To avoid delaying any dependent instructions, the chip has extensive register-bypass routes so that shared operands are available well before the write-back stage.

Digital intends to push the Alpha for NT servers rather than for the more traditional Unix. Coupled with keener pricing, this could become a winning strategy.

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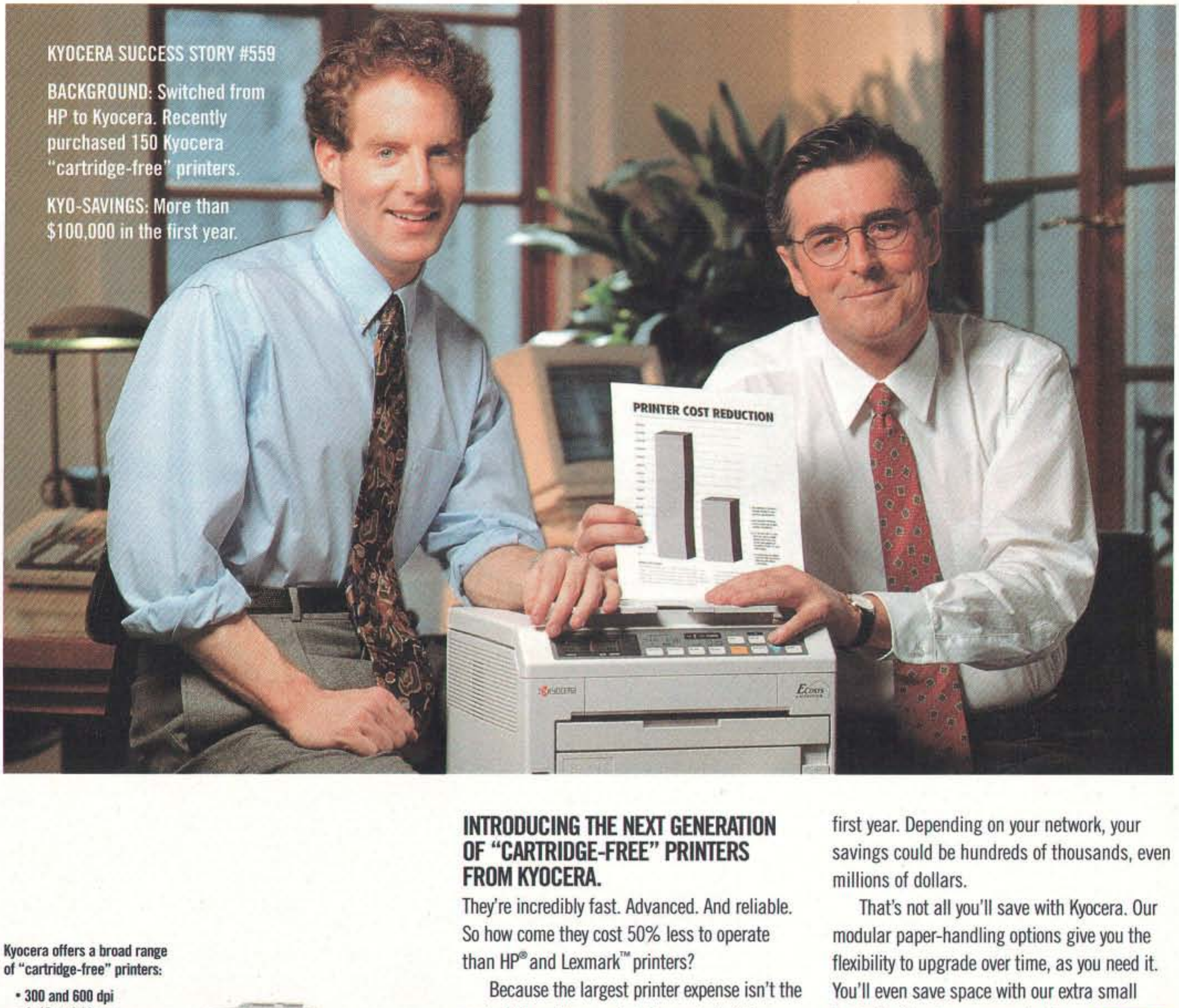

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CURRENT STATUS: Sampling

LIKELIHOOD INTRODUCTION DATE WILL BE MET: Good

TARGET CLOCK SPEED: 200 MHz

ESTIMATED PERFORMANCE:
300 SPECint92; 600 SPECfp92

FABRICATION PROCESS/FEATURE SIZE:
CMOS/0.35-micron

TECHNOLOGICAL ADVANTAGES:
The 64-bit R10000 has five functional pipelines, so it can potentially execute up to five instructions in any given cycle. With two double-precision FPUs, the R10000 is optimized for high floating-point performance.

TECHNOLOGICAL DISADVANTAGES:
For best performance, the off-chip secondary cache needs to be built from expensive SRAM.

PRIMARY MARKET: Graphics workstations, symmetric multiprocessing (SMP) servers, and supercomputers.

WHERE TO FIND: Mips, Mountain View, CA, (415) 933-6477; fax (800) 446-6477; http://www.mips.com.

MIPS

Next generation: **R10000**

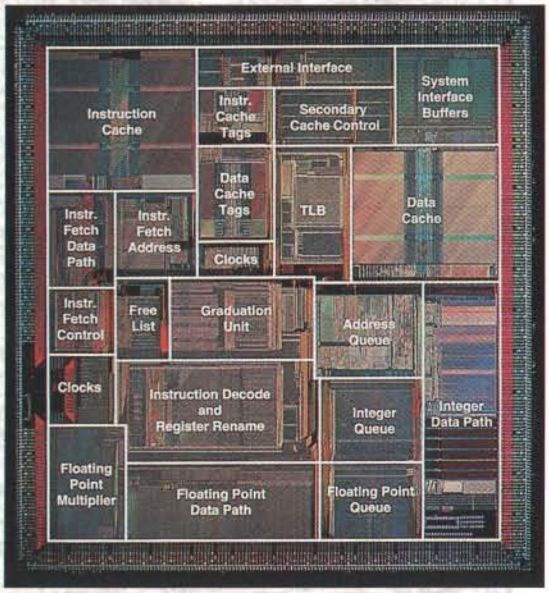
DOSSIER: The R10000 inherits its superscalar design from the R8000, which was created for the scientific supercomputing market. But the R10000 is intended for more mainstream applications. The R10000's adoption of dynamic instruction scheduling, which reduces the need to recompile software that's written for older-generation processors, is of particular benefit to Mips partner Silicon Graphics, which has a back-catalog of large and complex graphics applications.

The R10000 is the first single-chip superscalar processor from Mips. It features dynamic branch prediction to minimize pipeline stalls, with up to four levels of speculative execution, using register renaming to ensure that no results are committed to the real registers until the branch is resolved. The chip maintains a "shadow map" of its rename register mappings. In the event of a mispredicted branch, it just restores this map rather than having to clear registers and flush buffers, which reduces the penalty to one cycle.

The R10000 also features a radical out-of-order execution scheme. Instructions remain in program order through the first three pipeline stages, but following that they divert into one of three queues (which wait on the integer ALUs, the FPUs, or the load/store unit). These queues get served in whatever order that their resources become free.

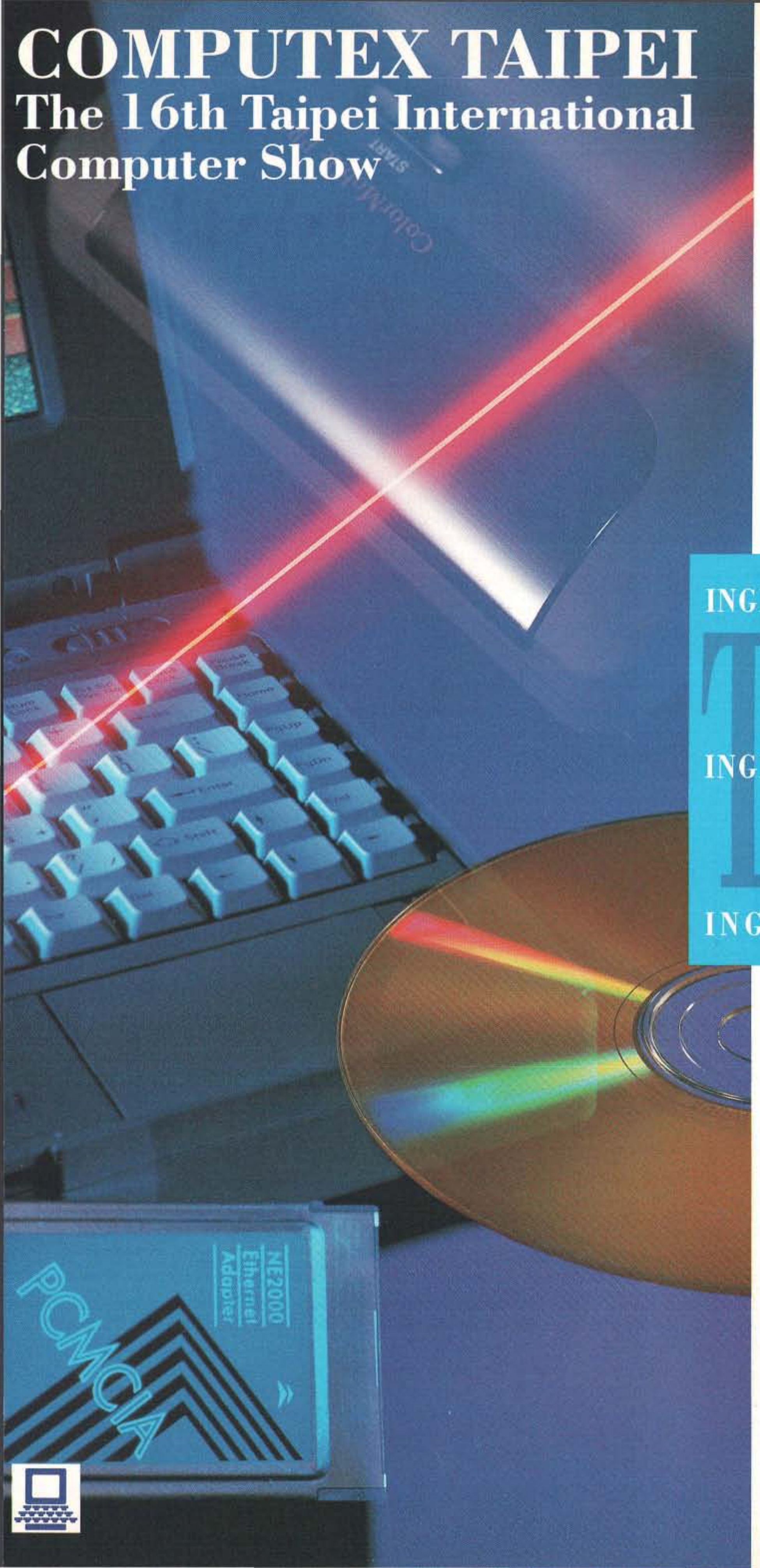
Program order is eventually restored by always "graduating" (which is Mips jargon for retiring) the oldest instruction first. This also ensures precise exception reporting. This hardware-assisted instruction reordering offers a great advantage to end users, because code that's written for Mips's older, scalar CPUs (e.g., the R4000) will gain almost the entire speed benefit without needing to be recompiled.

Although it has the potential to issue five execution instructions per cycle, the Mips R10000 can fetch and retire only four; a fifth cannot complete on the same cycle. Nevertheless, this excess of dispatch bandwidth offers more flexible opportunities for instruction scheduling, which means that the R10000 can complete four instructions per cycle for more of the time.



Twin FPUs in the R10000 processor mean exceptional SPECfp92 speeds.

One of the twin double-precision FPUs handles addition; the other processes multiply/divide and square-root functions. The latter is further split into two subunits that can execute a division operation and a square-root operation in parallel. An on-chip processor-bus interface permits up to four R10000s to be clustered in a multiprocessor configuration without requiring any glue logic.



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CURRENT STATUS: Design

LIKELIHOOD INTRODUCTION DATE WILL BE MET: Excellent

TARGET CLOCK SPEED: 250 to 300 MHz

ESTIMATED PERFORMANCE:
350 to 420 SPECint92; 550 to 660 SPECfp92

FABRICATION PROCESS/FEATURE SIZE:
Five-layer-metal CMOS/0.3-micron

TECHNOLOGICAL ADVANTAGES:
The UltraSparc-II is a 64-bit, four-way superscalar CPU that Sun optimized for multimedia and networking applications rather than for outright CPU performance.

TECHNOLOGICAL DISADVANTAGES:
The lack of hardware assistance for instruction reordering places a premium on compiler quality and requires companies to recompile older software to reap the benefits of the UltraSparc's enhancements.

PRIMARY MARKET:
Multimedia workstations.

WHERE TO FIND: Sun Microsystems, Sunnyvale, CA, (800) 681-8845 or (408) 774-8119; http://www.sun.com/sparc/Net.Engine.

SUN MICROSYSTEMS

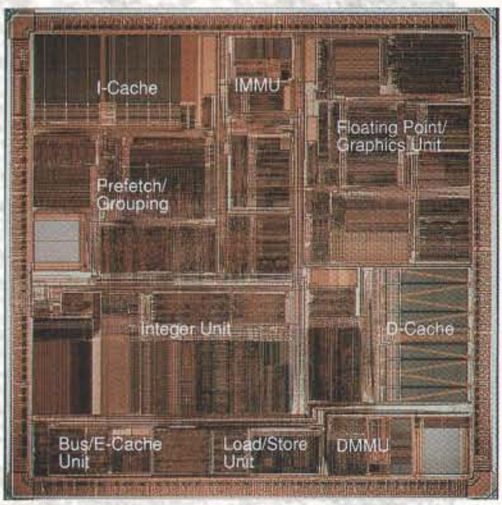
Next generation: **UltraSparc-II**

DOSSIER: An early adopter of RISC technology, Sun specified SPARC in 1988 as a scalable, "future-proof" architecture. However, by 1993, the SuperSparc implementation had begun to lag badly behind its competitors.

The UltraSparc, the fourth SPARC generation, will make up much of that lost ground. It contains no less than nine execution units: two integer ALUs, five FPUs (two for floating-point addition, two for floating-point multiplication, and one for floating-point division/square roots), a branch-processing unit, and a load/store unit. The UltraSparc has dynamic branch prediction integrated into its primary instruction cache and speculatively executes predicted branches, but it cannot issue instructions out of order. It relies on optimizing compilers to order them well.

The SPARC architecture has always offered register *windows*, eight overlapping banks of 24 duplicate registers that can preserve the processor state during context switches instead of doing an expensive write to memory. Compiler writers have often found these windows insufficient, so the UltraSparc adds an extra mechanism whereby a fresh window of eight registers becomes available every time an interrupt, memory management unit (MMU), or other trap occurs. This should greatly speed up the handling of multithreaded code.

To get high sustained system bandwidth, the UltraSparc uses a hierarchy of decoupled buses. The memory bus is 128 bits wide and runs at full processor speed. This connects via buffer chips to a 128-bit system bus that runs at half, one-third, or one-fourth the core speed. At the slowest level, the SBus is used for I/O to low-cost peripherals.



Sun Microsystems' UltraSparc offers nine execution units.

Sun implements this scheme at the hardware level by a crossbar switch chip, which is part of the support chip set. This chip can isolate the memory bus from the I/O bus so that instead of stalling during memory reads, the CPU continues writing to graphics or other I/O devices. The effect of this scheme is high overall bus utilization and sustainable 1.3-GBps throughput.

The UltraSparc-II uses the Visual Instruction Set (VIS), which includes 30 instructions for handling multimedia, graphics, imaging, and other integer-oriented algorithms. VIS instructions include addition, subtraction, and multiplication operations, which allow up to eight integer byte-wise or halfword-wise operations to be performed in parallel with a load or store operation and a branch in a single clock cycle.

This approach can be used to improve video performance. For example, for alpha blending (i.e., superimposing one image on top of another with a translucent top image), VIS includes instructions specifically designed to multiply the alpha value by the pixel values, a process that can take many floating-point operations.

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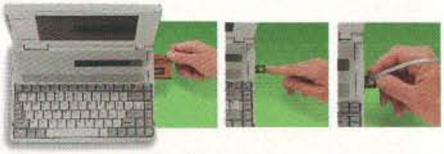

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Circle 313 on Inquiry Card.

HEWLETT-PACKARD

Next generation: PA-8000

CURRENT STATUS: Sampling

LIKELIHOOD INTRODUCTION DATE WILL BE MET: Good

TARGET CLOCK SPEED: 200 MHz

ESTIMATED PERFORMANCE: Greater than 360 SPECint92; greater than 550 SPECfp92

FABRICATION PROCESS/FEATURE SIZE: CMOS/0.5-micron

TECHNOLOGICAL ADVANTAGES: HP is the only RISC vendor to leave its primary instruction and data caches off-chip, where they can be made to be several megabytes in size. (RISC cores designed solely for maximum processing speed often perform badly on data sets that are too big to fit in the cache.)

TECHNOLOGICAL DISADVANTAGES: The off-chip caches run at full CPU speed and so need to be created with ultrafast SRAM, which makes them expensive to build.

PRIMARY MARKET: Commercial data processing; engineering and scientific workstations.

WHERE TO FIND: Hewlett-Packard, Cupertino, CA, (408) 447-4747; fax (408) 447-7983.

DOSSIER: Hewlett-Packard was an early entrant into the RISC market, launching its first 32-bit PA-RISC processor in 1986. Practically all PA-RISC chips go into HP's 9000 series workstations. HP shipped enough of these machines from 1991 to 1993 (prior to the introduction of PowerPC systems) to make PA-RISCs the biggest-selling RISC chips in dollar volume.

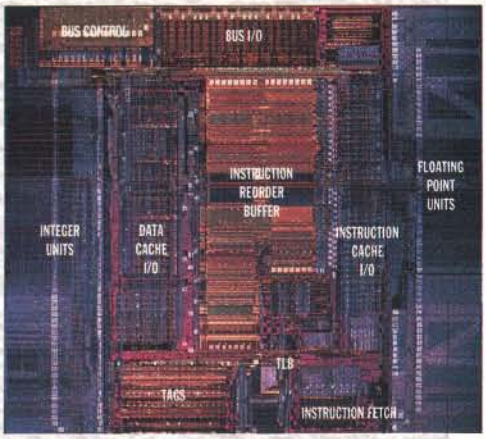
HP set up the Precision RISC Organization (PRO) to promote the use of its chips by other manufacturers. Then, in 1994, HP dropped the bombshell that it was teaming up with Intel to create a new architecture. This throws doubt on the future of the PRO.

The PA-8000 is a 64-bit, four-way superscalar design with a radical out-of-order execution scheme. The chip has 10 function units: two integer ALUs, two integer shift/merge units, two floating-point multiply/accumulate (MAC) units, two floating-point divide/square-root units, and two load/store units. The MAC units have a three-cycle latency and are fully pipelined for single-precision processing to deliver up to 4 FLOPS per cycle. The divide units have 17-cycle latency and are not pipelined, but they can be run concurrently with the MACs.

The PA-8000 uses a 56-instruction-deep instruction reorder buffer (IRB), which looks ahead to the next 56 instructions in the stream to find four that can execute in parallel. The IRB actually consists of two 28-slot buffers: The ALU buffer holds instructions for the integer unit and FPU, and the memory buffer holds load/store instructions.

Once an instruction has been stored into an IRB slot, the hardware watches all instructions being dispatched to the function units to see whether any of them supplies one of the operands for the instruction in the slot. The instruction in the slot runs only after the last instruction for which it is waiting has been dispatched. Each of the IRB's two buffers can dispatch two instructions per cycle, and in all cases it's the oldest instruction in the buffer that gets issued. Since the PA-8000 uses register renaming and retires instructions from the IRB in program order, it maintains a precise exception model.

HP designed the PA-8000 especially for commercial data processing and complex computational applications, such as genetic engineering, where data sets tend to be too big to fit into any conceivable on-chip cache. Thus, the PA-8000 employs external primary data and instruction caches. The slots in a third 28-slot buffer, called the address-reorder buffer (ARB), are associated one-to-one with the slots of the IRB's memory buffer. The ARB keeps the virtual and physical addresses of all dispatched load/store instructions. In addition, the ARB permits loads and stores to execute out of order while maintaining coherency, and it effectively hides the long latency associated with the addressing of off-chip caches.



Off-chip instruction and data caches make HP's design unique.

Finding a single source for all your mass storage needs, from WORM to multifunction, is definitely a big advantage. With this in mind, one name continues to rise to the top: Panasonic. Panasonic offers both the security of true WORM and the flexibility of multi-function in its wide range of optical drives and jukeboxes. Here's a quick look at just a few of Panasonic's offerings:

DEVICE DRIVER SUPPORT	OPERATING SYSTEM
Panasonic	*DOS, Windows, Mac, Novell, OS/2, SUN*
Corel	*DOS, Windows, Mac, Novell, OS/2*
Optisys	*DOS, Windows, Banyon, 3COM, Novell*
Ten X Technology	*AIX, NFS, TCP/IP, IPX, Network Envir.*
Software Architects	*Macintosh*
OTG	*Windows NT*
IMAGING & BACKUP SOFTWARE SUPPORT	**OPERATING SYSTEM**
FileMagic!	*Windows, Novell*
Optika	*Windows, Novell*
Paperclip	*Windows, Novell*
Cheyenne	*Novell*
Palindrome	*Novell*

WORM.

The Panasonic LF-5300A 5 1/4" WORM Optical Disk Drive. Ideal for backup/archival, CAD/CAM and image storage. It's large capacity (1.4 GB) and small size makes it an excellent choice if you're starved for space. Phase Change media makes it highly reliable and secure.

Multi-function.

Panasonic LF-7300A/LF-7304. The best of both WORM and re-writable capability in a single drive. High capacity (1.5 GB) and fast read and write times, aided by Panasonic's Phase Change technology, provides low cost storage for many data, imaging and CAD/CAM applications.

Multi-function Autochangers.

Panasonic offers a full range of jukebox solutions for near on-line data storage and retrieval. A 28 platter 42 GB single drive, 24 platter 36 GB dual drive, 50 platter 75 GB dual drive and a 300 platter 450 GB multi-drive jukebox.

All four models offer major advantages. (1) Increased storage capacity and quick and easy access to data. (2) Compact size. (3) Their ability to utilize either Rewritable or Write Once (WORM) media for increased flexibility.

PowerDrive

Keep your eye open for PowerDrive, Panasonic's new "2-in-1" drive. PD combines optical disk storage technology with the added convenience of a 4X speed CD-ROM player.

In the high capacity storage arena, Panasonic has definitely come out swinging. And with their huge selection of optical disk drives and jukeboxes in every imaginable capacity, they are definitely a contender to be reckoned with.

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CURRENT STATUS: Sampling

LIKELIHOOD INTRODUCTION DATE WILL BE MET: Good

TARGET CLOCK SPEED: 133 MHz

ESTIMATED PERFORMANCE: 225 SPECint92; 300 SPECfp92

FABRICATION PROCESS/FEATURE SIZE: CMOS/0.5-micron

TECHNOLOGICAL ADVANTAGES: The 620 can software-switch between 64- and 32-bit modes. It can also switch between big-endian and little-endian modes; this will be useful for running mixed OSes, as is envisioned in IBM's future plans.

TECHNOLOGICAL DISADVANTAGES: The performance of the 620 lags behind that of other next-generation RISCs.

PRIMARY MARKET: Graphics workstations, SMP servers, parallel supercomputers, and Macintoshes.

WHERE TO FIND: For Motorola information: (800) 845-6686 or (512) 434-1502; http://www.mot.com.PowerPC/ or Motorola@Selectnet.BGA.com. For IBM information: (800) 769-3772.

POWERPC ALLIANCE

Next generation: **PowerPC620**

DOSSIER: The PowerPC620 is the first 64-bit implementation of the PowerPC architecture. With 64-bit registers and internal data paths, and 7 million transistors, the 620 uses a larger die than—and is almost twice as complex as—the PowerPC 604. The 620 is a four-way superscalar design with six execution units: three integer ALUs, an FPU, a load/store unit, and a branch unit. The latter performs four-level branch prediction and speculative execution using a register-renaming scheme.

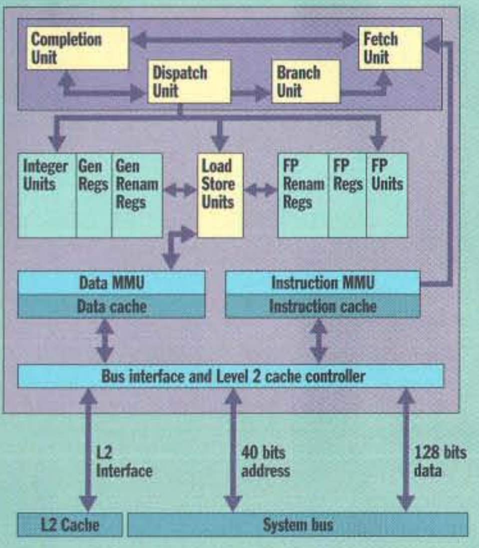
The microarchitecture of the 620's RISC core is similar to that of the 604. It differs mainly in its wider registers and data paths, and it has more reservation stations for speculative execution. Most of the overall performance enhancements come from a much-improved bus interface. There is now a 128-bit-wide memory interface that can fetch two 64-bit longwords per bus access and a 40-bit address bus that can address 1 TB of physical memory.

The bus interface offers integral support for a second-level cache of up to 128 MB, which can run at 100, 50, or 25 percent of the CPU's clock speed. This allows flexibility for the price of the memory parts used. The bus interface uses pipelined snoop responses, which reduce the latency due to bus snooping in SMP systems and improve throughput.

The 620 has the same 16-entry reorder buffer as the 604, which tracks instructions from dispatch to completion to facilitate out-of-order execution. However, the 620 releases up to four rename buffers per cycle (compared to the 604's two), making them more available to other instructions in the pipeline. As a result, the 620 needs only 16 rename buffers, compared to the 604's 20.

Nevertheless, the PowerPC's challenge to Intel seems to have lost some of its momentum. The alliance's declared intention was to offer twice the price/performance value of a comparable Intel CPU. The 601 processor achieved this against the Pentium. Since then, however, Intel has been progressively narrowing the gap in terms of maximum integer performance. A 200-MHz 620 processor may appear in mid-1996, but a 200-MHz P6 will also arrive around then. While Motorola continues work on a fast 604+ chip, other RISC vendors, including Mips and HP, seem to be overtaking the PowerPC alliance in the absolute-performance stakes.

620 Building Blocks



The 620 is the PowerPC Alliance's first 64-bit processor. It software-switches between 64- and 32-bit modes.

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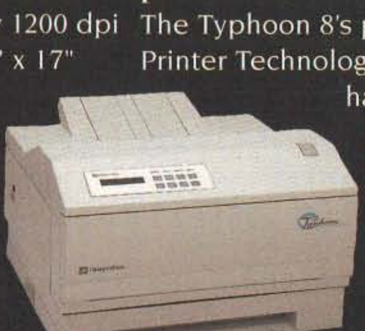

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Circle 70 on Inquiry Card (RESELLERS: 71).

WHY THE 615 MATTERS

Even though it's not in the British Museum's collection, emulation is RISC's Rosetta stone

LINLEY GWENNAP

Software is like water for a computer: Even the best hardware can't thrive without it. Intel-compatible PCs are awash in applications software, more than the platform can really use. Most RISC machines, however, can only sip slowly from the software spring.

One of the most intriguing answers for expanding the RISC software base is IBM's secretive PowerPC 615 project. IBM only grudgingly admits the project even exists. Although technical details are unavailable, reliable sources tell us this hybrid chip will natively run both PowerPC and x86 code. It is scheduled to ship in the second half of 1996. But the 615 has encountered many delays due to the complexity involved, so its shipping date could slip further. (See the text box "We Build a 615" for details on how a first-generation 615 might be built. Also see the text box "Alternate Views of the 615" on page 200 for details on a Pentium-pin-out design.)

Several roadblocks stand in the way of completing the 615. IBM has designed its own Blue Lightning 486, but certain restrictions in the Intel license would force IBM to design a clean-room x86 core for the 615. To properly execute x86 code, the PowerPC's memory management unit (MMU) and caches must be modified to correctly handle x86 quirks, such as unaligned accesses, segmentation, and self-modifying code. Finally, the entire design must be tested and verified to properly execute two distinct instruction sets, a task that has never been achieved.

If IBM executes this strategy well, it will have a chip that outruns the fastest Pentium chips when executing native-PowerPC code, while delivering strong Pentium-class performance on x86 applications. The price premium to end users could be only $30 to $40 over the price of a traditional PowerPC system. Such a system could convince users of x86-based PCs to switch to the PowerPC because they could keep their old software and gradually ease over to new RISC applications.

Better Software Could Win Out

But not everyone is convinced that the 615 is the best approach. Software emulation is the most common tactic RISC vendors use for building a software base. The best example is the 68000 emulator that Power Macs use to execute software written for older Macs. The emulator examines each 68000 instruction, decodes it, and faithfully—if considerably more slowly—replicates the actions that would have occurred in a real 68000 CPU.

Another option is the two-headed beast Apple sells: a system that has 486 and PowerPC chips in the same box. The cost of

We Build a 615

Our hypothetical design combines an x86 and a PowerPC 604 processor on one chip. By using the same package, the processors can share all external memory, support logic, the FPU, and even the on-chip cache to reduce costs.

We chose a 486 core because it is less than one-third the size of the Pentium core. Even so, the 486 with necessary modifications would make the die size of this 615 about 20 percent larger than a standard 604 chip. The 486 should be able to keep up with the clock speed of the 604; both could reach 133 MHz in current IC processes. At this speed, the combined chip would deliver roughly 75-MHz Pentium performance for x86 software and 150-MHz Pentium performance on native-PowerPC software. By the second half of 1996 (when IBM's 615 may debut), process advancements should allow both the 486 and 604 cores to reach as high as 180 MHz, giving a proportional increase in performance.

The Pentium's FPU is significantly faster than the 486's. But our design leverages the fast PowerPC FPU to achieve results competitive with a Pentium's, even with some 486-related overhead in the shared design.

The 486 core natively executes x86 instructions. This approach is faster and simpler from a design standpoint than alternatives that involve decoding and converting x86 instructions into RISC instructions. For a first-generation device, we think it makes sense to use a simple x86 core rather than adding a bulky translation unit. Translating x86 code into the PowerPC's RISC instruction set is difficult and may require modifications to the PowerPC core to handle x86 condition codes and other features.

Finally, a native-PowerPC OS would handle such things as the PC BIOS and core logic. DOS applications that directly access the hardware would have to be emulated, as in SoftWindows today. Performance would be mediocre for these types of programs.

As we have designed it here, the 615 would cost about 30 percent more to build than a standard PowerPC 604. At current margins, this would be an additional $30 to $40. However, business considerations would probably encourage a vendor such as IBM to sell the chip without charging a premium.

including two processors, along with their associated memory and support chips, makes this an expensive option that's unappealing to PC buyers.

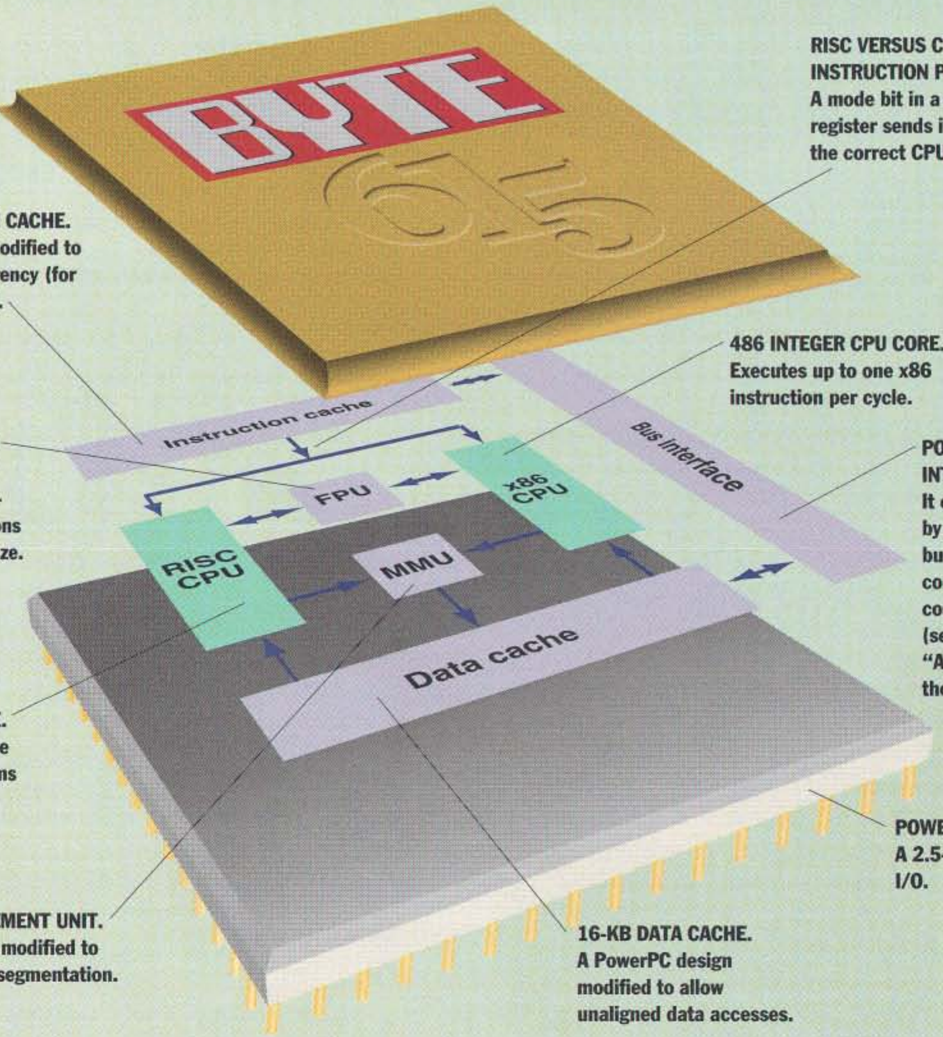
A third alternative is to improve the performance of software emulation with hardware "assist" functions that speed up the emulator. For example, a new RISC instruction called decode x86 could quickly translate an x86 instruction into an integer offset; current emulators must extract fields and do table lookups to decode instructions. Another assist would implement in hardware the x86 condition flags, which are difficult to emulate.

These and other assist functions could be added to a standard RISC chip at little cost. Such changes could cut by half the number of RISC instructions needed to emulate a CISC instruction. Even this strategy, however, leaves the x86 programs running at no better than a third of the speed of native code, and even that performance achievement requires specially modified RISC chips.

A more promising approach is to convert the x86 code into RISC instructions using a technique called binary translation. A special program converts each x86 instruction into one or more RISC instructions, creating a new version of the program that can execute natively on the RISC processor. Many x86 instructions can be replaced by a single RISC instruction, and most of the rest require only two or three. The translated program could run at 50 percent to 80 percent of the speed of a program that has been ported directly to the RISC platform.

The advantages of translation are good performance, no added hardware cost, and the ability to run on existing RISC chips. But the translation technology is tricky. No vendor has produced an x86-to-RISC translator that is reliable and delivers adequate performance. Digital Equipment has deployed a VAX-to-RISC translator for its Alpha processors and may be the closest to delivering a viable x86 translator.

If a vendor makes binary translation work, it could make obsolete hardware



RISC VERSUS CISC INSTRUCTION PROCESSING. A mode bit in a control register sends instructions to the correct CPU.

16-KB INSTRUCTION CACHE. A PowerPC design modified to support cache coherency (for self-modifying code).

486 INTEGER CPU CORE. Executes up to one x86 instruction per cycle.

POWERPC FPU. Shared with the 486 core to deliver fast execution of floating-point-math instructions and reduce the die size.

POWERPC 60X BUS INTERFACE. It could be replaced by a Pentium-style bus interface for compatibility with low-cost PC system logic (see the text box "Alternate Views of the 615").

POWERPC 604 INTEGER CPU CORE. Executes up to three PowerPC instructions per cycle.

POWER CONSUMPTION: A 2.5-V core with 5-V I/O.

MEMORY MANAGEMENT UNIT. A PowerPC design modified to support x86-style segmentation.

16-KB DATA CACHE. A PowerPC design modified to allow unaligned data accesses.

solutions such as the 615. In any case, watch for RISC PCs with fast x86 emulation coming to a store near you by the end of next year. These systems could begin to break the software stranglehold the x86 has on the PC industry. ■

Linley Gwennap is the editor of the Microprocessor Report, *an industry newsletter from MicroDesign Resources (Sebastopol, CA). You can contact him on the Internet or BIX at editors@bix.com.*

Alternate Views of the 615

TOM R. HALFHILL

What if almost everything that has been written about the PowerPC 615 is backward? What if IBM's goal is not to bring x86 compatibility to PowerPC systems, but rather to bring PowerPC compatibility to x86 systems?

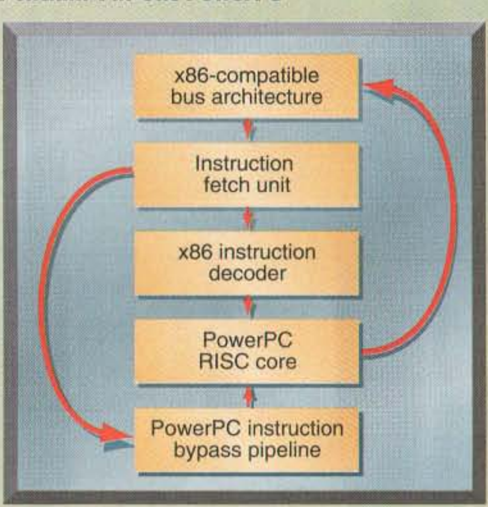
The difference is subtle but crucial. It means IBM would have to design a PowerPC chip that works on standard PC motherboards and performs as well as the latest x86 processors. Yet, the same chip would also make its native instruction set visible to PowerPC-compatible OSes and applications. In other words, you'd get the same multiplatform compatibility that has been rumored all along for the 615, but within an ordinary PC instead of a system based on the PowerPC Reference Platform (PReP), Common Hardware Reference Platform (CHRP), or Power Mac architectures.

Sources close to the project, but who spoke to us on the condition of anonymity, say IBM is developing exactly that kind of chip. Sources say this version of the PowerPC 615 will fit a Pentium socket on existing PC motherboards and deliver Pentium-level performance at a comparable price. It will also run native-PowerPC software at speeds competitive with other PowerPC processors.

This scenario raises a host of technical and marketing questions that only IBM can answer, and IBM isn't talking. However, by interviewing sources close to IBM, BYTE has pieced together an intriguing view of the PowerPC 615.

First of all, such a chip is technically feasible; similar x86 processors exist today. Intel's P6, AMD's K5, and NexGen's Nx586 all use a hybrid CISC/RISC design known as a decoupled microarchitecture. This design combines a RISC-like execution core with a sophisticated x86 instruction decoder. The decoder translates x86 CISC instructions into simpler RISC-like operations that execute more efficiently in a superscalar RISC core. It's a way of adopting the advantages of RISC while maintaining compatibility with x86 software.

Sources say that IBM is developing a similar chip that uses PowerPC as the RISC core. The chip also has an x86-style bus architecture and a Pentium pin-out, so it fits into Pentium sockets. However, unlike the P6, K5, and Nx586—which use RISC-like instructions for internal purposes only—IBM's hybrid CPU can make both instruction sets visible to an OS.


Pentium-Pin-out PowerPC

x86-compatible bus architecture
Instruction fetch unit
x86 instruction decoder
PowerPC RISC core
PowerPC instruction bypass pipeline

Based on information obtained from sources close to IBM, this speculative design for a Pentium-pin-out PowerPC chip shows how a PowerPC core could be united with an x86-compatible bus. The dual-mode CPU would support both instruction sets, routing x86 instructions through a special decoder that converted the CISC instructions into native-RISC instructions.

One catch, according to sources, is that the hybrid chip can't easily switch between x86 and PowerPC modes. You have to boot up the system in one mode or the other to get full performance. Also, one source said the chip has a "fairly big die," which would make it relatively expensive to manufacture. But he said it's still cheaper than putting x86 and PowerPC processors in a system.

Another drawback is that a hybrid CPU on a PC motherboard would need special versions of Windows NT and OS/2, apart from the existing PReP/CHRP versions. And it almost certainly wouldn't run the Mac OS, which supports the largest installed base of PowerPC software.

Nevertheless, if this variation of the 615 goes into production, it could be IBM's way of hedging its bets. The hybrid CPU could compete directly with the Pentium for sockets on PC motherboards, ensuring some kind of future for PowerPC chips in case PReP and CHRP fail. It would also let the PowerPC infiltrate the mainstream PC market.

IBM is believed to have several variations of the 615 in development. The first announcements are expected in the first half of 1996.

Tom R. Halfhill is a senior editor for BYTE in San Mateo, California.

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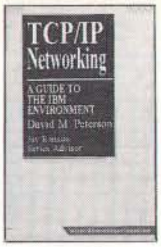

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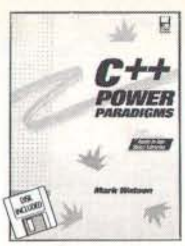

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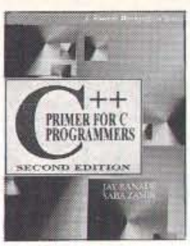

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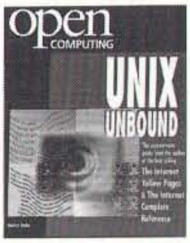

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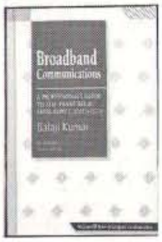

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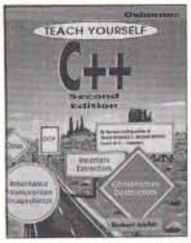

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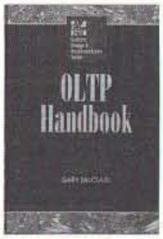

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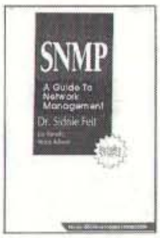

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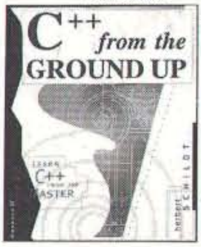

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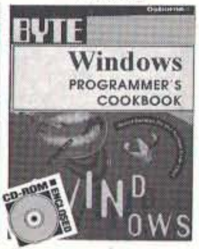

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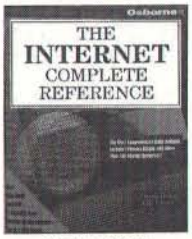

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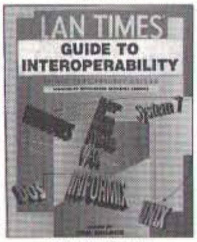

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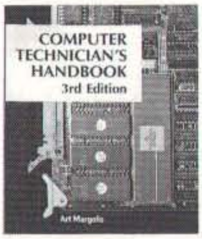

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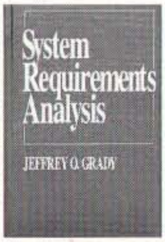

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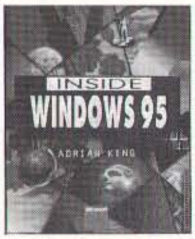

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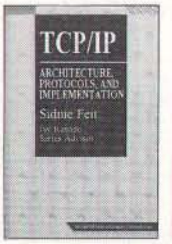

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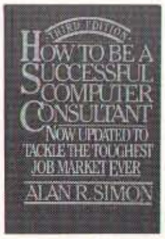

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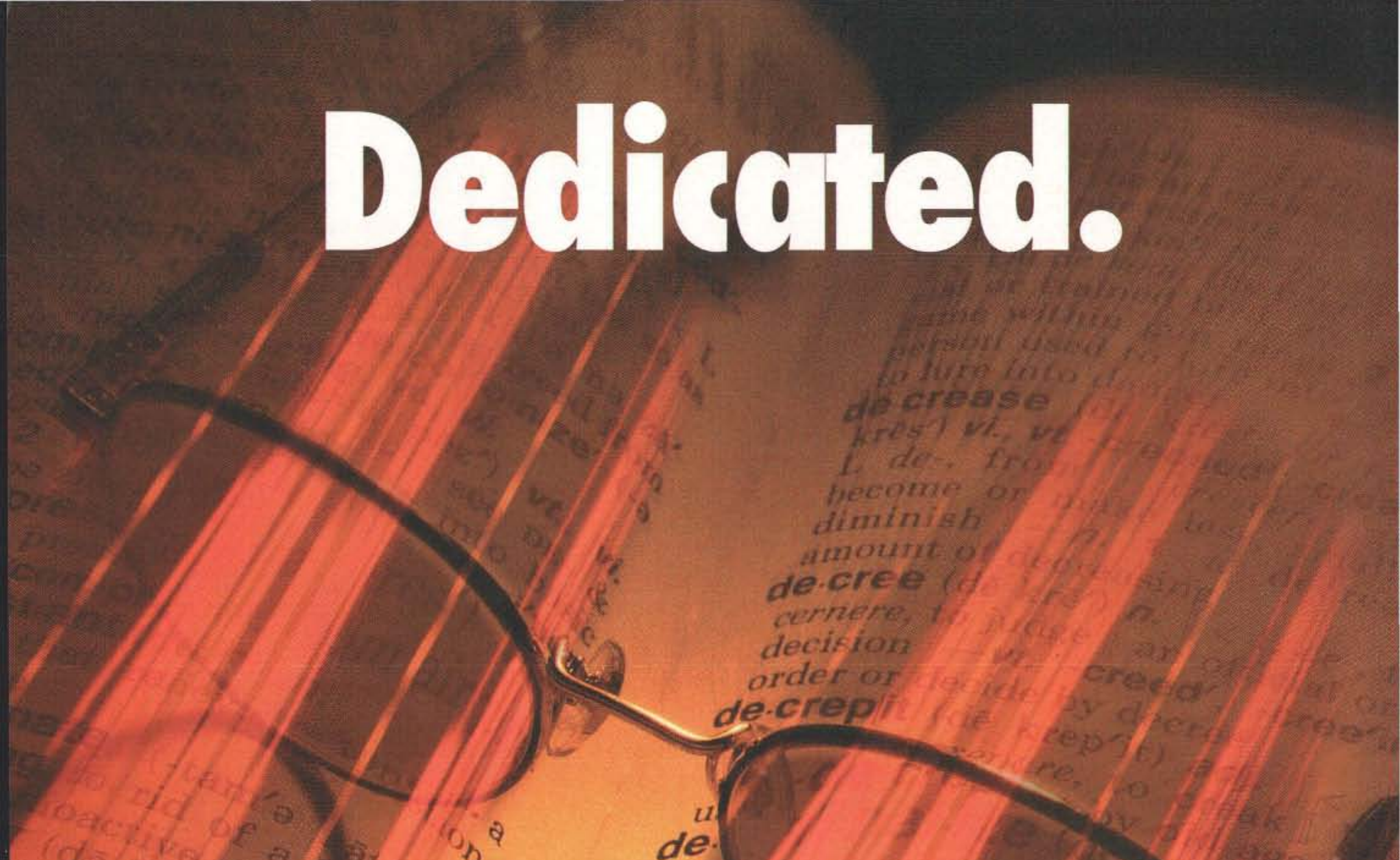

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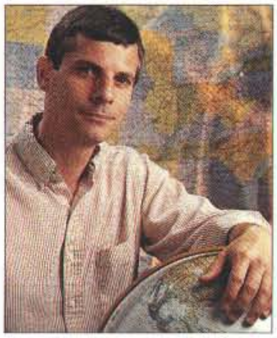


AL KARVEY © 1995

How we built two Web applications that showcase both private and public networking

If you work for a company that employs more than a hundred people, it's probably set up a lot like BYTE: one headquarters and a bunch of satellite offices. Linking far-flung intracorporate LANs is a problem that many companies solve poorly, if at all. Linking those intracorporate sites to extracorporate ones is a problem that most companies don't even *try* to solve.

World Wide Web technology can tackle both. I'll show how this month with a pair of applications, one private and one public.

The private application, `demos`, converts reports filed by BYTE staff members into a password-protected Web archive that only fellow BYTE staff members can view and search. The public application, `vpr` (which stands for virtual press room), empowers vendors to submit product and technology announcements directly to BYTE's Web server; it builds a Web archive that BYTE's staff or any other Web user can navigate and search.

Web vs. Notes

Nearly every day of the week, vendors demonstrate their products and technologies to BYTE editors in Peterborough; San Mateo, California; and New York. We file reports on these demos in our private conference on BIX, where we also hold an ongoing debate about which emerging technologies matter most and how best to cover them.

BIX is a fine discussion forum, but a lousy text database. Once a report scrolls by, it's hard to find it again. The deluxe tool for distributing, managing, and discussing this kind of semistructured data is clearly Lotus Notes. Pervasively deployed throughout a company, Notes enables even ordinary users to build `demos`-like applications—a stunning simplification of client/server software development. The problem is *getting* Notes deployed as pervasively as the Web technology that's becoming the kudzu of the corporate LANscape.

You wouldn't toss out your Notes server and put in a Web server to run the likes of `demos` and `vpr`. But if you don't already have a Notes infrastructure in place, these applications might make you stop and think. They're easy to build, they work within and across corporate networks, and they run on nearly every kind of client.

Destination Host Unreachable

The Internet's pervasive, but is it a reliable transport for mission-critical applications? Not by a long shot. Start with a network that's anarchically managed, dismantle and privatize its backbone (NFSnet), and dump in a few million new users (from America Online, CompuServe, MSN, and Prodigy). You'll end up with a mess.

Folks in the Internet business assume—not unreasonably—that it'll get cleaned up sooner or later. But right now, slowdowns and partial outages are common. I access the Internet primarily from four points: two local providers and two national providers. More often than I like to admit, a `ping` command from any one of these access points returns the infuriating reply "Destination host unreachable."

Experiments with `traceroute` reveal no single culprit; congestion seems to afflict a variety of intermediate networks in a variety of ways. Those on the East Coast of the U.S. know that afternoons, when both Route 128 and Silicon Valley are in full swing, can be especially sluggish. At an Internet seminar I recently attended in New York, not a single afternoon presenter could fetch a complete home page.

Still, a global network that works most of the time is far more powerful than a local one that always works. You wouldn't build a real-time trading system on today's Internet, because such applications require guaranteed low latency and high availability. But applications like `demos`

RFC 1597 REVISITED

In "Live Wire" (August BYTE), I discussed the pros and cons of using non-unique IP addresses to form private corporate networks. Use of the 192.1.1 Class C network for this purpose is an Internet folk tradition, I said. RFC 1597 proposes instead to reserve one Class A network, 16 Class B networks, and 256 Class C networks for non-unique addressing.

Why isn't 192.1.1 one of the Class C networks that RFC 1597 proposes to reserve? Well, you can't always trust folk traditions. As it turns out, 192.1.1 is a registered network. Walter "Doc" Urbaniak, a network engineer with BBN Corporate Telecommunications, contacted me to set the record straight.

For years, 192.1.1 has been registered to Bolt, Beranek, and Newman. Urbaniak says that because 192.1.1 is widely but wrongly believed to be available for testing, BBN doesn't even try to use it anymore. "We even found some instances in which vendors were shipping hardware preconfigured for the 192.1.1 network," he adds.

He agrees that private IP networking can be a useful thing, endorses RFC 1597, and configures his own routers not to accept those networks as sources from the Internet. "However," he says, "I wish people wouldn't just assume that 192.1.1—and also 192.1.2 and 192.1.3 [also registered to BBN]—are test city."

and `vpr` can deliver useful benefits even on an imperfect substrate.

The Power of Plain ASCII

Some months ago, I posted a form (see the figure "A Simple Tagged ASCII form") to our staff conference on BIX and asked editors to use it to structure their demo reports. This simple but surprisingly powerful technique is all you need to make an E-mail or conferencing system work as the data-input front end to a database.

Because the `demos` database that these forms go into is really just a collection of Hypertext Markup Language documents, the form we use could make everyone tag entries in HTML, but that would be overkill. A simpler format, like the one shown in the figure, is easier for users and works just fine.

It matters not at all *which* tags you use; it matters only *that* you use them and do so consistently. With Perl or any other text-processing language that supports regular expressions, it's trivial to convert any well-formed ASCII tags into HTML. (Why plain ASCII? All word processors can produce it, Internet mailers can reliably exchange it, and text-processing tools can easily parse it.)

A Simple Tagged ASCII Form

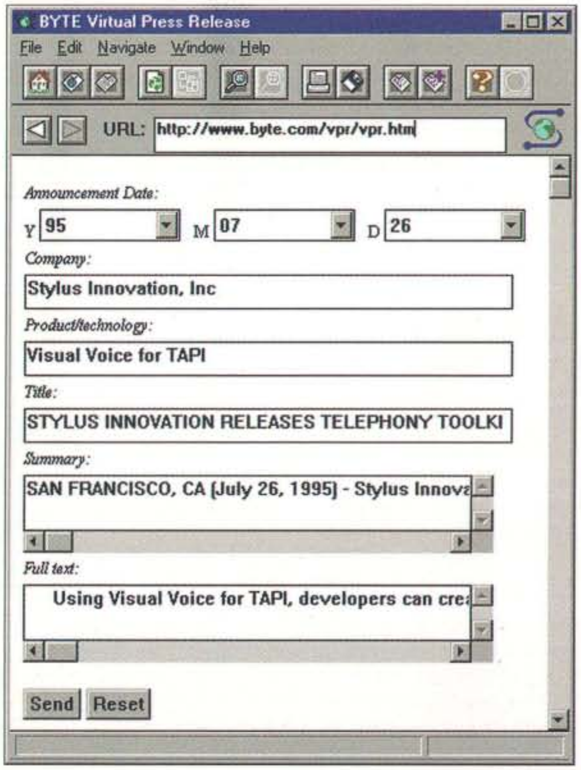
```
<visitdate>
95-05-24
<company>
XYZ, Inc.
<product>
XYZ Internet router
<attendees>
DaveA, DaveE, DaveR
<summary>
The XYZ router....
<report>
This RISC based router.....
<recommendations>
Candidate for upcoming roundup?
```

You can use any old tags for the front end of a database of HTML documents; just use them consistently. Perl makes conversion to HTML a snap.

Structure of a vpr Record

```
<html><head>
<title>VENDOR INFO: 95-08-11 /
   XYZ Company / XYZ Internet
     Router</title>
<meta name=date content=
   95-08-11>
<meta name=comp content=
   XYZ Company>
<meta name=prod content=XYZ
   Internet Router>
</head><body>
<h1>BYTE Virtual Press
   Release</h1>
...
```

The HTML <meta> tag is a convenient place to tuck arbitrary name/value pairs. You can use the values stored here to create ordered views of an HTML document archive.



URL: http://www.byte.com/vpr/vpr.htm

Announcement Date:

Y 95 M 07 D 26

Company:

Stylus Innovation, Inc

Product/technology:

Visual Voice for TAPI

Title:

STYLUS INNOVATION RELEASES TELEPHONY TOOLKI

Summary:

SAN FRANCISCO, CA [July 26, 1995] - Stylus Innova

Full text:

Using Visual Voice for TAPI, developers can cre

Use this form to submit a press release or product announcement to BYTE. Copy text into each of the fields from your GUI word processor. If you supply HTML, we'll use it. If not, we'll automatically convert URLs into links.

For `demos`, I wrote a little Epsilon Extension Language (EEL) program to do the HTML conversion and built a simple table of contents that lists the reports in reverse chronological order. When a bunch of demo reports had accumulated in the BIX conference, I downloaded them, ran the converter, indexed the resulting HTML files with freeWAIS (see "Web Search," September BYTE), moved the archive to the Web server, and secured it with a password.

Securing Private Data

The `demos` application is an example of a private application that uses the public Internet as its transport. (Another flavor of private application runs only *within* private IP networks hidden from the public Internet; see the text box "RFC 1597 Revisited.") Because `demos` runs on the Internet, it's accessible from anywhere—offices, homes, hotel rooms, and phone booths around the world. But since the Internet's one big party line, how can you publish documents intended for only limited distribution on a Web server that the whole world can see?

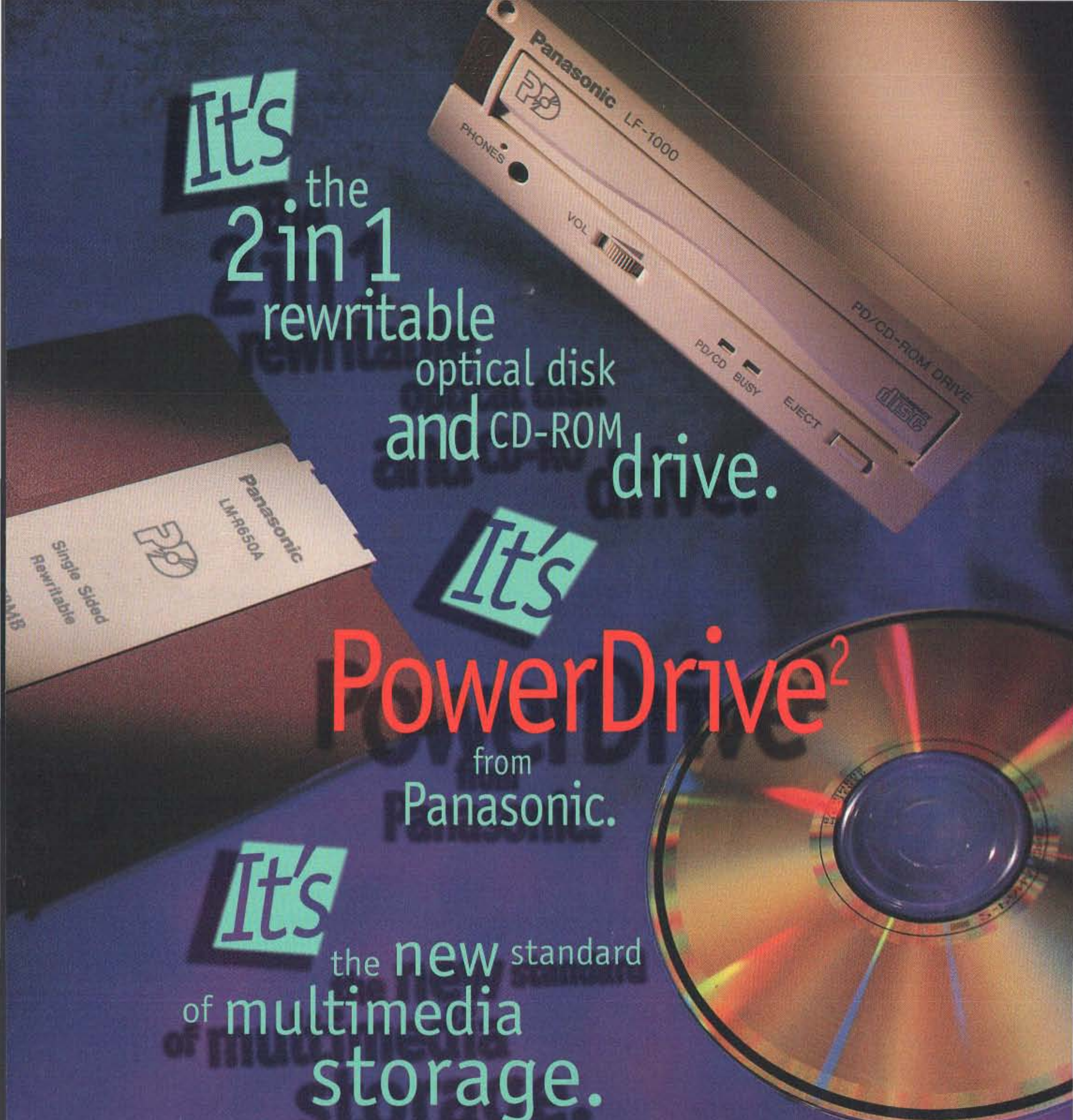
The first line of defense is to disallow browsing of the directory tree that the Web server controls. If nobody can see the DEMOS directory on the server, and no readily accessible pages contain links to it, then nobody's likely to find and explore it. Many Web archives and applications begin life this way: as prototypes that are public but are advertised only to a small audience.

If you need more than the most casual form of privacy, though, you'll want to guard against unauthorized use of your private archive's hidden uniform resource locators (URLs). Most servers, following the style of the National Center for Supercomputing Applications (NCSA) and European Laboratory for Particle Physics (CERN) servers, support two forms of authorization: by user name/password and by IP address.

User name/password methods rely on a directory of Web users that's distinct from the underlying network OS's (NOS's) user directory. This duplication is something that I normally abhor because I've spent too many hours synchronizing E-mail, fax-server, and other user directories with NetWare binderies. I want LAN-based services to synchronize with NOS user databases, and I'm often disappointed when they don't.

But Web applications are a different breed. They're inherently global. And unless your corporate LAN is in the minority that's running NetWare 4.x or Vines, you probably don't have a global directory to tap into, so it makes sense to create one for this purpose.

Don't be scared off by the grand unified theory of directory services, however. In practice, securing a Web archive is quite simple. If your private application doesn't need to track individual users, you can



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even have everyone share a single, common account, as we do with `demos`.

With the other approach—restriction by IP address—you can, in principle, form a virtual private network on the Internet. If our Peterborough, San Mateo, and New York subnetworks were 199.125.99, 199.125.100, and 199.125.101, respectively, our Web server could be configured to allow only the nodes on those subnetworks into the DEMOS directory.

In practice, however, this doesn't work so well. Allowing only these subnetworks defeats the worldwide access that makes this kind of application so compelling. But if you also allow access for IP addresses from the likes of BIX, CompuServe, and MSN so that traveling staff can reach the Internet through these services, you can't distinguish between staff and nonstaff users: Both will present the same IP addresses.

User/Password Authentication: Unix and NT

To secure a DEMOS directory on the BYTE Network Project's BSDI 2.0 machine, which was running the NCSA Web server, I first created a password file with this command:

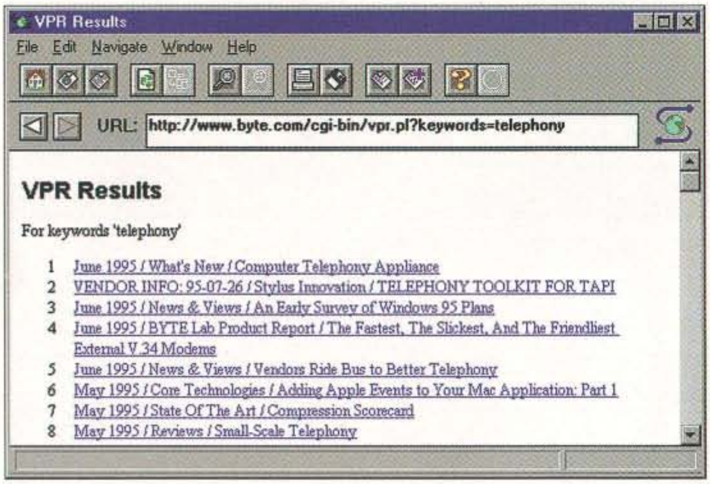
```
htpasswd -c /pwdir/.passwd
DEMOS_USER
```

This prompts for and confirms a password, creates in `/pwdir` the password file `.passwd`, creates in `.passwd` the user name `DEMOS_USER`, and prompts for a password. Then, in the DEMOS directory that I wanted to protect, I put a file called `.htaccess`, which contains these lines:

```
AuthUserFile
  /pwdir/.passwd
AuthGroupFile /dev/null
AuthName ByPassword
AuthType Basic

<Limit GET>
require user DEMOS_USER
</Limit>
```

This setup limits HTTP `GET` requests (the kind that fetch documents) to user `DEMOS_USER`, specifies password authentication, and then refers the server to `/pwdir/.passwd` for `DEMOS_USER`'s password.



http://www.byte.com/cgi-bin/vpr.pl?keywords=telephony

VPR Results

For keywords 'telephony'

1. June 1995 / What's New / Computer Telephony Appliance
2. VENDOR INFO: 95-07-26 / Stylus Innovation / TELEPHONY TOOLKIT FOR TAPI
3. June 1995 / News & Views / An Early Survey of Windows 95 Plans
4. June 1995 / BYTE Lab Product Report / The Fastest, The Slickest, And The Friendliest External V.34 Modems
5. June 1995 / News & Views / Vendors Ride Bus to Better Telephony
6. May 1995 / Core Technologies / Adding Apple Events to Your Mac Application: Part 1
7. May 1995 / State Of The Art / Compression Scorecard
8. May 1995 / Reviews / Small-Scale Telephony

The hit list includes BYTE articles and vendor-supplied info.

On the pair of NT Web servers I've been using—O'Reilly and Associates' WebSite and Process Software's Purveyor—there's none of this Unix-style, text-file-oriented administration. Both offer GUI tools that you use to create users and groups, specify passwords, and authorize access to resources. WebSite provides tabbed dialog boxes that you use to define users, groups, and *realms*, which contain both users and groups. Purveyor installs a File Manager extension that you use to define and interactively test access controls.

These graphical tools are great when you're sitting at the server's console. But they're no help at all when you need to modify access restrictions on a distant server. NT's lack of support for both telnet- and X Window System–style remote access is its most serious drawback as a platform for Web service. The Unix way is more primitive, but for remote administration it's far more effective.

Searching the Archive

For this project, I used the Simple Web Indexing System for Humans (SWISH) 1.1 (ftp://ftp.eit.com), which compiled easily and ran smoothly under BSDI 2.0. SWISH is just an indexing and search tool. To use it in a Web application, you need to wrap it in a front-end form that sends in search keywords and a back-end filter that formats the SWISH output as HTML—more trivial chores for Perl scripts.

Once the `vpr` archive was searchable, I realized it could merge with the BYTE on-line archive. That way, a user of the archive who enters the search keyword *telephony* sees a list of hits that includes BYTE articles mentioning telephony, as well as vendor-supplied press releases and white papers on telephony (see the screen above). Therefore, users get more information, vendors get more exposure, and BYTE gets better control over vital—but hitherto intractable—sources of information.

I'm excited about `vpr` because I'm swamped with paper press releases. Vendors: I hate to say it, but if you send me paper, I might as well burn it for all the good it does either you or me. So drop on by http://www.byte.com and try `vpr`. It will ensure that BYTE staff members worldwide can find your information when they need it.

How long will it take to move the stuff from a private editors-only archive to the public BYTE archive? The gating factor is administrative, not technical: We just need someone to verify what we republish to the world. Nothing else prevents this internal corporate application from becoming a global one. That's why the Internet, if it can get past the era of brownouts, just might live up to its hype. ■

Jon Udell (judell@bix.com) is BYTE's executive editor for new media.

TOOLWATCH

Weblint
(http://www.unipress.com/web-lint/)
HTML Validation Service
(http://www.halsoft.com/html-val-svc/)

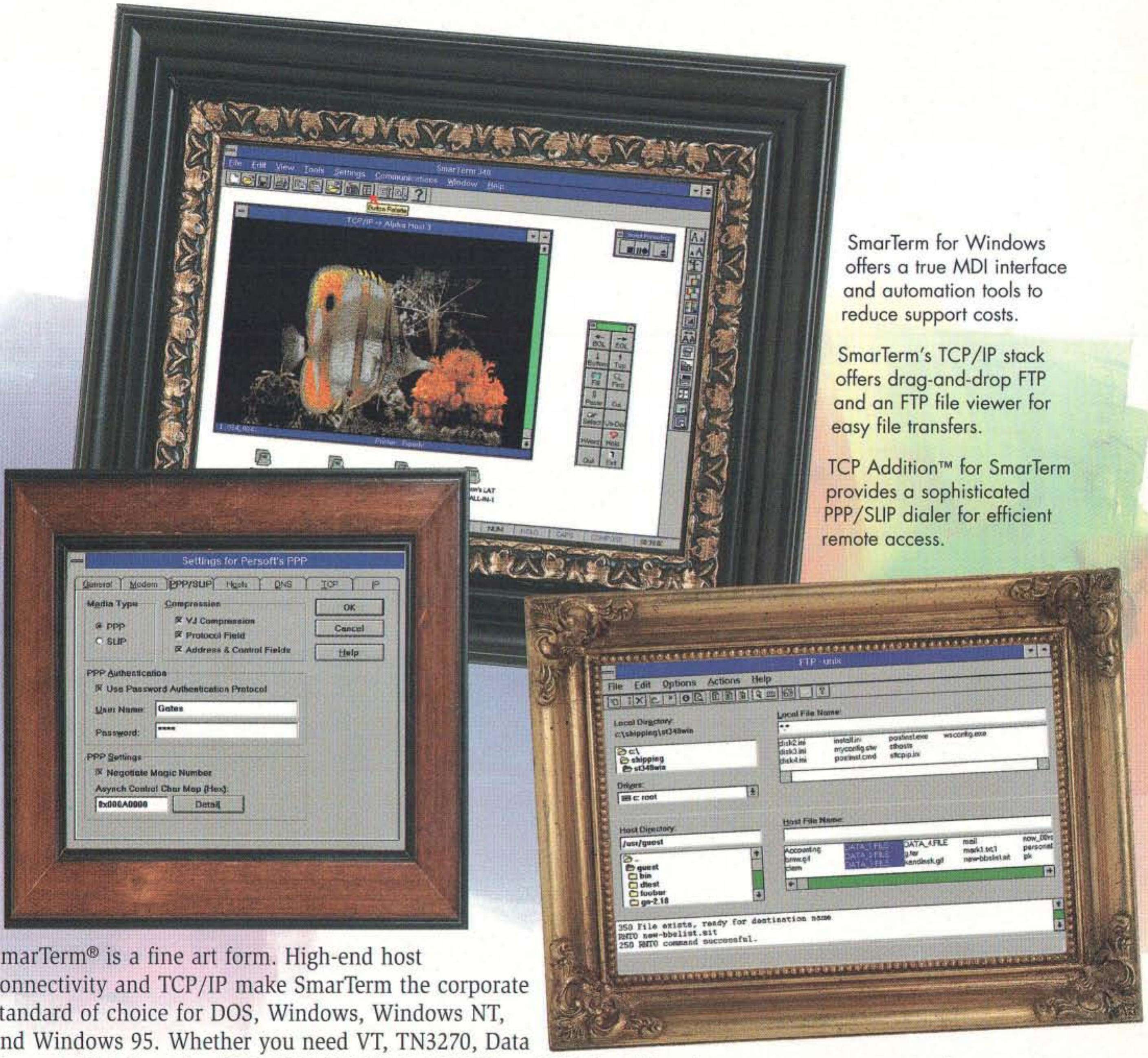
BYTE reader Adrian John Howard recommended these on-line HTML checkers to me, and I recommend them to you. Point either one of them at one of your own URLs to find out which HTML sins Netscape has been allowing you to commit.

BOOKNOTE

Programming Perl, $29.95
by Larry Wall and Randall Schwartz
O'Reilly and Associates, 1995
ISBN 0-937175-64-1

O'Reilly and Associates says that an update to the Perl bible is forthcoming. Until then, this is it: the complete guide to the programming glue that holds the Web together.

The Art of Smart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TCP/IP -> Alpha Host 3
Settings for Persoft's PPP
General Modem PPP/SLIP Hosts DNS TCP IP
OK
Cancel
Help
Detail
FTP - unix
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Local Directory:
Local File Name:
Drives:
Host Directory:
Host File Name:

Media Type
● PPP
○ SLIP

Compression
☒ VJ Compression
☒ Protocol Field
☒ Address & Control Fields

PPP Authentication
☒ Use Password Authentication Protocol
User Name: Gates
Password: ****

PPP Settings
☒ Negotiate Magic Number
Asynch Control Char Map (Hex): 0x000A0000

```
350 File exists, ready for destination name
RNTO new-bbslist.sit
250 RNTO command successful.
```

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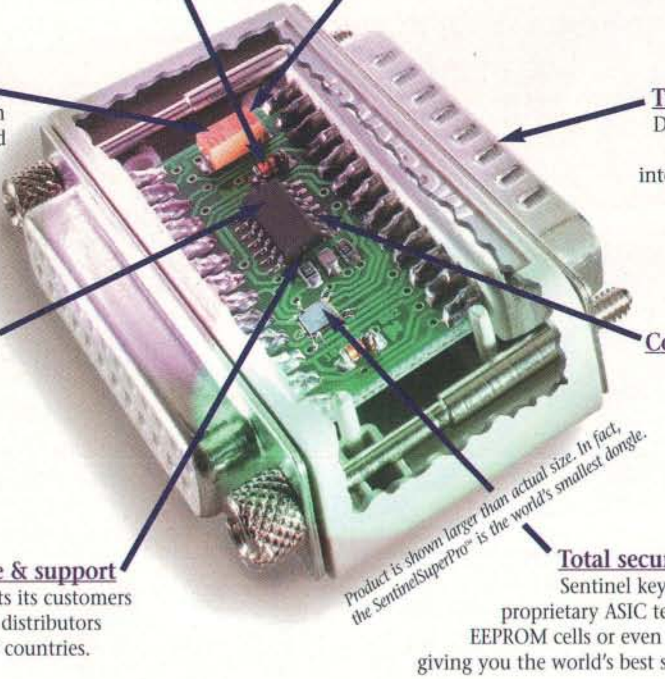

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Circle 91 on Inquiry Card.

NT Roars on the 604

Faster than P6 and Mips, slower than Alpha, the PowerPC 604 makes a mean NT workstation

DAVE ROWELL

Systems running Windows NT on the PowerPC 604 RISC processor are finally here. Our cross-platform BYTEmark tests show these machines have processor performance nearly twice that of Pentium PCs at the same clock speed. The 604 also compares favorably to other RISC chips, although the latest 21164 Alpha chip is still 30 percent to 50 percent faster (see "Alpha Stays Ahead" on page 210).

We tested three of the first available systems: Motorola's 100-MHz PowerStack Series E 604-100P server, IBM's 133-MHz Personal Computer Power Series 850, and a beta PowerPlay^2 604/133 from Austin Direct that provides symmetrical multiprocessing (SMP) with two 133-MHz 604 chips. Performance testing with BYTEmark and several native PowerPC NT applications shows that the 604 makes a mean NT workstation.

Two PowerPC 604 workstations and a server (from left to right): Motorola's PowerStack Series E 604-100P server, Austin Direct's PowerPlay^2 604/133, and IBM's Power Series 850.

No screws, no cables. You can dismantle Motorola's PowerStack systems down to the bare chassis without tools.

DENNIS WARNESKY © 1995

All three systems we tested comply with the PowerPC Reference Platform (PReP), a hardware standard that hardware-component and operating-system vendors can design to. PReP leverages off existing x86-based standards, specifying the PCI expansion bus, for example. As a result, the three systems we review share many similarities besides the 604 processor. All have expansion card risers, for example, and two use similar PCI SCSI-2 or Ethernet controllers. PReP systems run Windows NT 3.51 and AIX 4.1 now, and they should be running OS/2 by year end and Solaris next year.

TECHNOLOGY FOCUS

601 to 604

Microsoft didn't release Windows NT 3.51 for the PowerPC until June, not long after IBM and Motorola fixed problems with the bug-delayed PowerPC 604 chip. Since we first tested the PowerPC systems, performance has improved dramatically. While the speed increase comes partly from refinements in Motorola's compiler technology, it's mostly due to the switch from first-generation 601 chips to the second-generation 604.

From BYTEmark results at the same clock speed, the 604 comes out roughly 30 percent faster than the 601. While both chips are 32-bit implementations of the 64-bit PowerPC architecture, the 604 is more superscalar than the 601. It can do more work per clock cycle. Here are some major differences between the two chips:

PowerPC 601	PowerPC 604
2.8 million transistors	3.6 million transistors
Three independent execution units	Six independent execution units
Dispatches up to three instructions per clock	Dispatches up to four instructions per clock
Completes up to three instructions per clock	Completes up to five instructions per clock
Static branch prediction	Dynamic branch prediction
32-KB unified cache	Separate 16-KB instruction and data caches
Eight-way set associative cache	Four-way set associative cache

For consistency with our first round of NT workstation testing (see "Fastest NT Workstations," March BYTE), we requested high-end system configurations. The tested machines have 64 MB of memory, 1 GB of hard drive capacity, a CD-ROM drive, accelerated graphics (PCI-based SVGA), and an Ethernet adapter. We ran as many of the same benchmarks as were available for PowerPC, but under Windows NT Workstation 3.51 instead of 3.5.

Along with the BYTEmark benchmarks (formerly the BYTE Native Mode benchmarks), we tested application performance with North Coast Software's PhotoMorph 2.01 (beta SMP version), a multimedia image-processing program, and with an alpha version of Bentley Systems' MicroStation 95, a CAD package (the equivalent of version 5.5). NSTL's InterMark test for NT wasn't ready for PowerPC.

The PhotoMorph Swirl test creates a 2.5-MB AVI file using a swirl distortion; the test basically measures floating-point performance. The MicroStation tests were driven by a script developed by NSTL. We ran the tests in both 8- and 24-bit color depths, because the IBM Power Series 850's built-in graphics doesn't support 24-bit color. PhotoMorph and, to some degree MicroStation 95, take advantage of NT's SMP capabilities, giving added performance when a system has multiple

Alpha Stays Ahead

The last time we tested NT workstations, Alpha 21064A-based systems were the clear performance winners. Today's 133-MHz PowerPC 604 systems provide the same BYTEmark performance as those Alpha boxes did at 275 MHz. Since then, however, Digital Equipment Corp. has come out with the faster 21164 CPU, a chip that includes among its enhancements both a 16-KB primary cache and a built-in 96-KB L2 cache (see "Alpha Rides High," October 1994 BYTE).

Eager to test the 21164, we got our hands on one of the first systems to use it: DeskStation's Raptor 3 (DeskStation Technology, Lenexa KS; (913) 599-1900). DeskStation has developed an architecture called UniFlex that allows the same system board to take processor cards carrying either Mips or Alpha CPUs, with Windows NT as the operating system. Our test machine came with a 266-MHz 21164 module (the 300-MHz version wasn't yet available) loaded with 2 MB of write-back L3 cache. Other performance features include a claimed 900-MBps bus to external cache and a 128-bit 150-MBps bus to external memory.

The $15,000 price includes 64 MB of system memory, a 1-GB Seagate ST31230 SCSI drive, a 2x CD-ROM drive, a 4-MB Diamond Stealth 64 PCI graphics card, built-in Ethernet, and a 17-inch ViewSonic 17E monitor. Performance testing with BYTEmark put the Raptor 3 far ahead of the crowd. Its CPU performance was 40 percent to 60 percent faster than 275-MHz 21064A systems and single-processor 133-MHz PowerPC systems (see the BYTEmark test results below). The 300-MHz version should be another 13 percent faster.

processors (as in the case of Austin's PowerPlay^2). MicroStation didn't support SMP in our previous testing.

Austin Direct PowerPlay^2

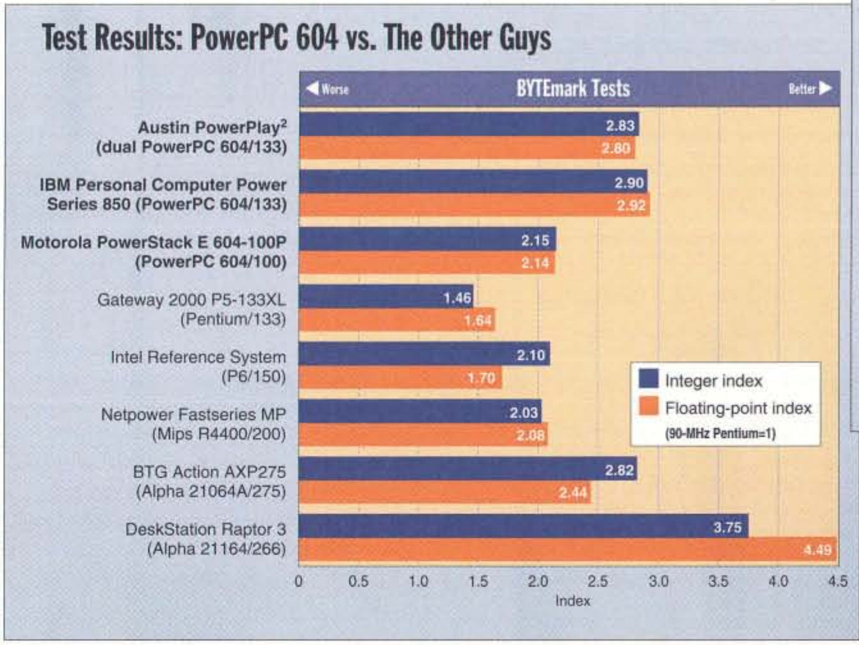
We examined a dual-processor PowerPlay^2 604/133 beta system that should be available by the time you read this. (List price with 64 MB will be $9995.) Several jumper wires crisscrossed the motherboard, and a flash BIOS upgrade arrived later to enable the 512-KB L2 cache, but we ran into few problems. (FirePower, which designs and manufactures this system for Austin Direct, makes a similar system for Canon, but it wasn't ready for review.)

Notable features include the two 133-MHz 604 processors, ECC memory, and a memory-bus-direct graphics system controlled by FirePower's Powerized Graphics L1A9403 chip, which moves graphics data from the CPU to the 4-MB VRAM frame buffer over the system's 128-bit-wide memory bus. The CPU does the graphics work. A Philips SAA7196 video decoder/scaler chip has its own 2-MB VRAM frame store buffer. The FirePower motherboard provides asynchronous I/O, which decouples I/O from the memory bus so that activities like disk I/O don't hold up CPU/memory operations.

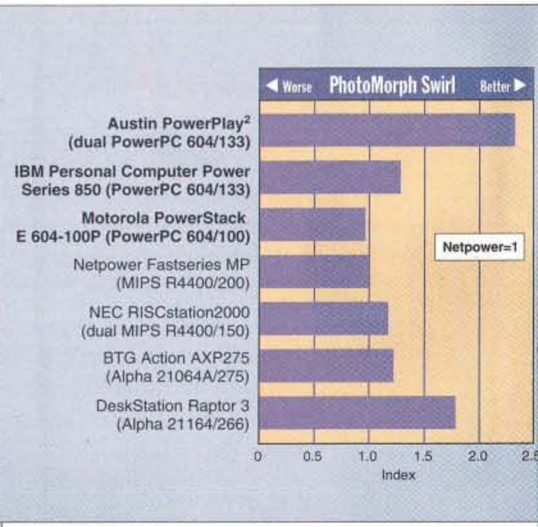
The BYTEmark CPU test exercises only one processor at a time. With both CPUs enabled, the Austin trailed the 133-MHz IBM Power Series 850 just slightly, due to the overhead of managing two CPUs. But in the PhotoMorph test, two CPUs gave the PowerPlay^2 a great advantage; it performed better on this test than any machine we've seen yet. Display of graphics isn't amenable to SMP under NT, but MicroStation uses SMP when it can. However, with no independent graphics processor, the PowerPlay^2 fell 19 percent behind the IBM system in the 8-bit MicroStation CAD test.

IBM Power Series 850

IBM's Power Series 850 is also aimed at the desktop. It has IDE drives, but no built-



Test Results: PowerPC 604 vs. The Other Guys



The BYTE cross-platform BYTEmark CPU test shows the PowerPC 604 favorably compared to other CPUs. The Austin PowerPlay^2 604/133 trailed the 133-MHz IBM Power Series 850 just slightly, due to the overhead of managing two CPUs. Two processors gave the PowerPlay^2 a strong advantage in the PhotoMorph Swirl test, but not in the MicroStation CAD test (results not shown), where graphics controllers are a big factor.

POWERPC SYSTEM FEATURES

	AUSTIN DIRECT POWERPLAY^2 133	IBM PERSONAL COMPUTER POWER SERIES 850	MOTOROLA POWERSTACK SERIES E 604-100P
Processor(s)/Memory			
CPU(s)/speed (MHz)	Two PowerPC 604s/133	PowerPC 604/133	PowerPC 604/100
Secondary cache (all direct mapped, write-back)	512 KB split (will be shared in final version)	512 KB, synchronous	256 KB
Memory bus width/speed	128 bits/66 MHz	64 bits/66 MHz	64 bits/66 MHz
RAM (standard/as tested/maximum, in MB)	32/64/256, ECC	16/32/192, parity	32/64/256, parity (ECC optional)
Storage			
Hard drive	One 1-GB Fujitsu M1606 SAU 3.5-inch SCSI-2	One 1-GB IBM DPEA-31080 3.5-inch EIDE	Two 525-MB Toshiba MK2428FB 2½-inch SCSI-2
CD-ROM drive	Hitachi IDE (4x)	IBM CRMC-FX400C3 IDE (4x)	Toshiba XM-4101B (2x)
Drive bays	Two accessible 5¼-inch, two accessible 3½-inch	Two accessible 5¼- by 1-inch, one 3½-inch floppy, two internal 3½-inch drives	Three 5¼- by 1-inch drive bays (two accessible), one floppy
Graphics			
Graphics card	Built-in	Built-in	Number Nine GXE64 Pro PCI graphics card
Graphics processor	Powerized Graphics 128-bit L1A9403, Philips SAA7196 video decoder/scaler	S3 64-bit Vision864	S3 64-bit Vision964
Video memory (as tested/maximum, in MB)	6/6 VRAM (includes 2-MB video frame store)	2/2 DRAM	4/4 VRAM
Pixel clock maximum	135 MHz	135 MHz	220 MHz
Max. 24-bit resolution (refresh rate)	1024 by 768 (75-Hz)	No 24-bit driver support	1280 by 1024, 76-Hz.
Max. resolution (color depth, refresh rate)	1280 by 1024 (16-bit, 75-Hz)	1280 by 1024 (8-bit, 72-Hz)	1600 by 1200 (16-bit, 76-Hz)
Monitor	17-inch Austin	17-inch IBM 17S/S Sight and Sound	none
Optimal resolution (refresh rate)	1280 by 1024 (70-Hz)	1280 by 1024 (77-Hz)	not applicaple
Dot pitch (mm)	0.26	0.27	not applicaple
Expansion interfaces/ports			
Total slots	Two 33-MHz PCI, two ISA (none shared)	Two shared 33-MHz PCI/ISA, three ISA (one half-length)	Three 33-MHz PCI
SCSI	Built-in PCI, 8-bit Fast SCSI-2, internal and external connectors	none	Built-in PCI, 16-bit (Wide) Fast SCSI-2, internal (8-bit) and external (16-bit) connectors
Serial	Two 9-pin 57.6-Kbps	Two 9-pin 115.2-Kbps	Two 9-pin 19.2-Kbps asynchronous; two 26-pin mini-D 1-Mbps synchronous
Parallel	One IEEE 1284 25-pin	One IEEE 1284 25-pin	One IEEE 1284 36-pin high-density
Networking			
Interface	Built-in PCI Ethernet (10Base-T)	Built-in PCI Ethernet (10Base-T)	Built-in PCI Ethernet (10Base-T (tested), thin-net, or AUI)
Pricing			
Price (as tested)	$8295 (32 MB RAM)/$9995 (64 MB RAM)	$5607 (32 MB RAM)/ $7303 (64 MB), monitor $1410 extra	$6869 (32 MB RAM)/$9279 (64 MB), no monitor
Price includes	CD-quality audio with speaker and mic, videoconferencing camera	Built-in 16-bit "business" audio with speaker and mic	Optional "business" audio (on floppy-drive card)
Warranty	Three years, parts and labor; first year on-site; lifetime 24-hour, 7-day tech support	Three years, parts and labor; first year on-site	Five years, parts and labor, depot; or three years on-site (2-day response); or one year on-site (best-effort response) with 7-day, 24-hour phone support
FCC Rating	Class B pending	Class A	Class A

in SCSI, and an 8-bit graphics system—an S3 Vision864 accelerator chip with only 2 MB of frame buffer. Graphics options include IBM's H10 PCI card with 4 MB of VRAM and a video coprocessor. "Business" audio and 10Base-T networking are also built in.

Security starts with a locking front cover. Once it's unlocked, you can open the mostly metal case without turning any screws. There is a ZIF socket that can take an upgrade CPU, though IBM has no firm plans for this socket.

Like the Motorola system, the Power Series 850 uses the Motorola MPC105 PCI Bridge/Memory Controller chip and therefore has a 64-bit memory data bus and a 32-bit address bus. The 850 Series comes in 100- and 120-MHz versions, which have a 256-KB asynchronous cache instead of a 512-KB synchronous cache. As noted, the 133-MHz system performed slightly better with non-SMP benchmarks than the Austin Direct PowerPlay^2 did.

The $7017 test system came with IBM's 17-inch 17S/S Sight and Sound monitor, which provides speakers, microphone, and an empty enclosure for an optional video camera. The unit also comes with IBM software that can take advantage of the 604's floating-point capabilities, including an MPEG decoder.

Motorola PowerStack Series E

Motorola Computer Group sells its systems only through reseller channels and offers a limited selection of peripherals, expecting resellers to add their own. The PowerStack Series E is designed as a desktop server. It lacks ISA slots and an internal IDE connector but provides four serial ports (two synchronous), built-in Fast and Wide SCSI-2, and Ethernet. You can stack a SCSI expansion module on top of the Series E. The system provides over-temperature detection for the CPU and also for the external SCSI module.

The 100-MHz PowerStack Series E 604-100P is a solid, cleverly built unit. You can quickly take the whole system apart (including removal of the motherboard and power supply) without touching a screw or a cable; there are none.

Company Information

Austin Direct PowerPlay²
IPC Technologies
Austin, TX
(800) 752-1577
(512) 339-3500
fax: (512) 454-1357
http://www.ipctechinc.com
Circle 1147 on the Inquiry Card.

Personal Computer Power Series 850
IBM Personal Computer Co.
Somers, NY
(800) 772-2227
fax: (800) 426-4329
Circle 1148 on the Inquiry Card.

PowerStack Series E 604-100P
Motorola Computer Group
Tempe, AZ
(800) 759-1107, ext. PR
(512) 434-1526, ext. PR
http://www.mot.com/computer/
Circle 1149 on the Inquiry Card.

The system we tested (list price $9279) came with a Number Nine GXE64 Pro PCI graphics card (loaded with 4 MB of VRAM) but no monitor. It also included two Toshiba 525-MB SCSI hard drives and a CD-ROM drive. The floppy-drive card plugs into its own proprietary slot on the expansion card riser and also holds the business-audio option.

In fact, all the drives are on cards so that they can plug in without using cables. The hard-drive cards can hold up to three 2½-inch SCSI drives. By plugging in two of these cards, you can pack this server with six hard drives (plus the CD-ROM drive). You will need a second PCI SCSI controller if you want to add the stacking SCSI expansion module, which holds four 5¼-inch drives. Normally, it can run off the built-in SCSI controller.

In terms of performance, the 100-MHz Series E suffered in comparison with the 133-MHz IBM and Austin systems, but it performed proportionately to its lower clock speed.

Are You Running NT Software?

PowerPC NT systems are priced very competitively with equivalently configured x86-based systems, particularly when you consider that they perform faster than the initial 150-MHz Intel P6 systems we've tested. While NT allows running of 286-level 16-bit software under emulation, that feature becomes increasingly less appealing as more 32-bit Windows 95 software arrives. To justify buying a RISC-based NT system, you must not only require top performance with a major processor-intensive application, but you must also be able to satisfy most of your software needs with NT applications. ■

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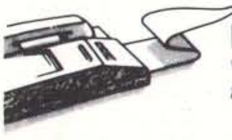

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Circle 115 on Inquiry Card (RESELLERS: 116).

Enterprise Database Managers

You can run a whole business on DB2/2, Oracle, or SQL Server. But there are important differences in scalability, support, and reliability.

BARRY NANCE

If you work with important business information such as customer names, orders, billings, and payments, a relational database management system (RDBMS) is essential. Running an RDBMS on a networked desktop PC puts the data close to the people who use it.

For this review, we looked at the latest versions of three PC-based RDBMSs that have the power and the capabilities needed to run an enterprise: IBM's DB2/2 2.1, Oracle's Oracle 7.1, and Microsoft's SQL Server 6.0.

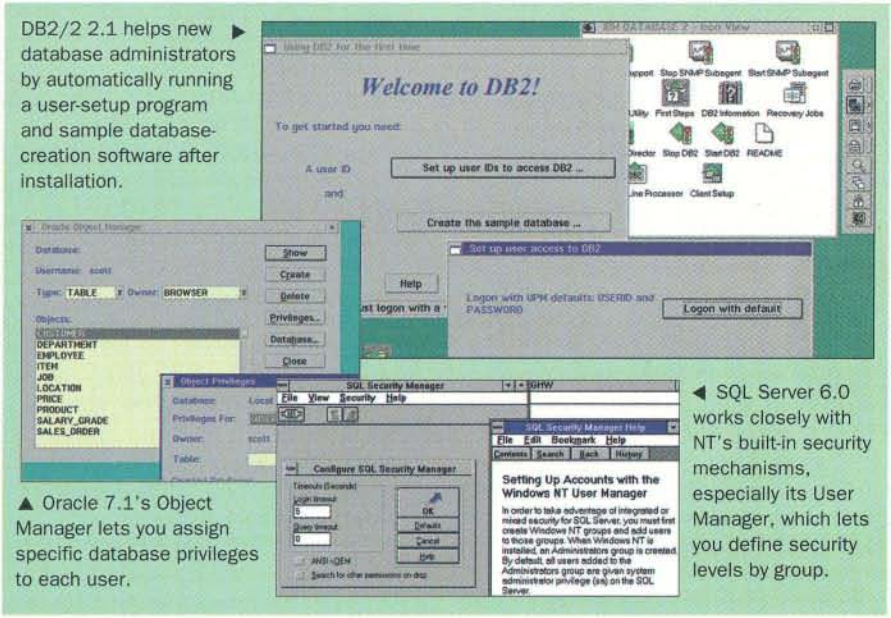
All three systems offer stored procedures, triggers, and constraints. A stored procedure is a set of processing steps that executes on the database server PC rather than on the client. A trigger is a stored procedure that fires when a specified event (row insertion, deletion, or updating) occurs. A constraint is a business rule in the database that specifies acceptable values or relationships among data fields. Constraints let you enforce referential integrity relationships among your database tables; you can ensure, for example, that no one can delete a customer's account in one table if billing records for that customer still exist in another table.

These are big-league features that, along with higher capacity and performance, help distinguish these database managers from such products as Microsoft Access, Lotus Approach, and Borland Paradox.

Stress Test

Overall, we found Oracle to be the best of the three. It scales the most consistently across PCs, minicomputers, and mainframes (see the chart "Comparing Relational Database Features" on page 216), and it offers more platform choices than DB2 or SQL Server. We recommend Oracle for enterprises with many remote sites of diverse sizes. It is also mature, a market leader, and rich in features.

DB2/2, though it scales almost as well as Oracle, doesn't offer you as big a range of choices; for example, the next higher gradation of DB2, which runs on IBM's RS/6000 RISC workstation, has relatively little third-party support. Still, for companies downsizing to client/server and that already have DB2 on a mainframe, DB2/2 is an excellent desktop solution. It's also a good choice for organizations that need the utmost in reliability.



DB2/2 2.1 helps new database administrators by automatically running a user-setup program and sample database-creation software after installation.

Oracle 7.1's Object Manager lets you assign specific database privileges to each user.

SQL Server 6.0 works closely with NT's built-in security mechanisms, especially its User Manager, which lets you define security levels by group.

SQL Server runs only on Microsoft Windows NT, which limits its scalability to 486-based PCs through DEC Alpha-based systems and, eventually, PowerPCs. But it offers excellent integration with Visual Basic and with Microsoft and third-party applications.

To gauge reliability, we wrote an "RDBMS killer" program to find out how each product behaves at its saturation point. The multithreaded program, emitting SQL operations to each RDBMS at an ever-increasing rate, ran directly on the database server rather than across the LAN. All three products died during the stress test, as we expected. We wanted to study the failure itself, not measure how long each RDBMS lasted (long before your own database software died, you would have gotten more hardware and scaled your systems upward).

DB2/2 failed gracefully, shutting down and leaving the database undamaged. But when SQL Server and Oracle died, we had to run repair utilities before we could resume using the database.

DB2/2 2.1

IBM continues to make DB2 more consistent across PCs (running OS/2), RS/6000s (AIX), AS/400s (OS/400), and mainframes. IBM has targeted other platforms for DB2 as well, including HP-UX, Solaris, Sinix (Siemens Nixdorf Unix), and Windows NT. But DB2 is not yet one database product with a single code base. Slight differences exist among versions, most notably in the Data Definition Language (DDL) statements you use to allocate and initialize a new database. The bottom line: You sacrifice some portability with DB2.

We tested DB2/2, the OS/2 version that supports symmetric multiprocessing (SMP). DB2/2 supplies programming interfaces for a wide variety of computer languages, including C, C++, COBOL, and FORTRAN. IBM's own VisualAge and many third-party products (such as Watcom's VX-REXX) are excellent add-on tools you can use with DB2/2.

You can configure DB2/2 to replicate data among a set of database servers. DB2/2 can also work through Distributed Database Connection Services (DDCS) or other middleware products to interface with mainframe DB2 databases. Administration is easy, either locally or remotely, through GUI administration software. For remote sites that don't have their own database administrator, DB2/2 offers remote administration tools. A separate product, Visualizer, lets you build, update, or query your database.

DB2/2 2.1 subjects SQL statements to one of nine levels of optimization just prior to processing those statements. The nine levels, which can be configured by a database administrator or set by application software, allow precise tuning of database response times. You'd use level 0 or 1 for SQL that's already optimized by the programmer. Higher levels let DB2/2 examine and reformat SQL submitted by, for instance, a front-end query tool such as Microsoft Access.

Programs can emit either "dynamic" or "static" SQL to DB2. Dynamic SQL is compiled at run time; it can be a string of text, for instance, that someone types into a program at the command line. In contrast, static SQL consists of statements, embedded directly in the program, that are fully known at compile time. Precompile and postcompile steps, part of a process IBM calls "binding," store the static SQL statements in files with a .BND extension. In general, static SQL executes much faster than dynamic SQL.

Oracle 7.1

Oracle runs on more than 90 platforms (about 60 of which are Unix environments). Because the database software is essentially the same code for each platform, Oracle is amazingly consistent on different platforms. Moving an Oracle database from one platform to another is a simple matter of using the export and import utilities supplied with the package. Database administration and design are also consistent among platforms. The same DDL for creating an OS/2 Oracle database can also create a NetWare NLM, NT, or Unix one.

Oracle takes advantage of SMP in environments that offer multiple CPUs (OS/2, NT, AIX, SCO). The previous version of Oracle provided only "strict" data replication through two-phase commit or unsynchronized table snapshots. Version 7.1 adds loose, time-delayed replication from a primary database site and optimistic replication that allows any one database site to update without waiting for other sites to catch up. You can also configure Oracle to replicate table updates onto another (remote) Oracle database or a DB2 mainframe database.

Administering Oracle is easy, since the OS/2 and NT versions come with native GUI tools, but you administer the NetWare NLM version through an over-the-wire Windows interface. Oracle, through a separate product, offers remote administration tools for distant sites that don't have their own database administrators.

Oracle supports the use of triggers, stored procedures, and database constraints through its PL/SQL database server programming environment. It also supports dynamic SQL and, for embedded SQL, a form of static SQL. However, unlike in DB2/2, there is no separate "bind" step the programmer performs during development. And, to improve processing of SQL statements, Oracle uses an optimizer to predigest SQL. (See the Technology Focus box below for an explanation of SQL processing in all three products.)

TOP THREE REASONS TO BUY...

DB2/2

- **Supports faster-executing static SQL**
- **Works on SNA networks**
- **Is easy to program**

Oracle

- **Supports row locking**
- **Scales in fine gradations from PCs to mainframes**
- **Is consistent across platforms**

SQL Server

- **Works well with Visual Basic and shrink-wrapped Windows programs**
- **Has good Windows NT-based security features**
- **Replication is easy to set up and administer**

Oracle isn't quite as easy to program as DB2/2, and it doesn't have tight, thread-oriented integration with the host operating system. On the other hand, Oracle enjoys a great deal of support from third-party software vendors, and SQL*NET is an excellent, multiplatform-oriented SQL de-

TECHNOLOGY FOCUS

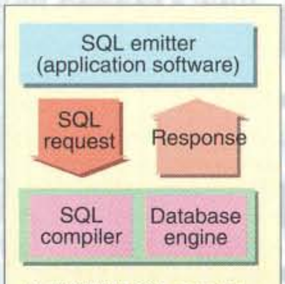
SQL Compilers: The Performance Nexus

The database engine's SQL compiler is arguably the most important part of an RDBMS. It must recognize and understand natural language (SQL), then turn the SQL statements into "instructions" it gives to the database engine's retrieval and update processes. The job is compounded by speed requirements.

SQL compilers process SQL statements in five basic steps. The first step parses the SQL, examines it for syntax errors, then converts the SQL parse tree into an internal representation. The second step examines the reformatted SQL to ensure that executing the statement won't violate referential integrity. This step also notes whether the database engine should process a constraint or trigger for the SQL.

Next, the SQL compiler rewrites the SQL statement, replacing view references with actual column names and transforming the SQL for processing by the optimizer. The transformation eliminates redundant joins, adds implied predicates, and converts INTERSECT clauses to EXISTS subqueries.

In the fourth step, the optimizer uses cost-based algorithms to determine the most efficient execution method for the SQL statement. It finds the best join order, for example, and it decides whether the execution of the SQL statement will be CPU- or I/O-bound. The optimizer chooses an execution path for the SQL statement that will result in the quickest response from the database engine.



An RDBMS's SQL compiler has a central role in making efficient queries.

The fifth step "remembers" the essence of the SQL statement for later comparison with other SQL statements; the SQL compiler keeps a history of how well it optimizes statements so it can "learn" the fastest ways to access the database. After this fifth step, the SQL compiler delivers the compiled, optimized SQL statement to the retrieval and update processes in the database engine.

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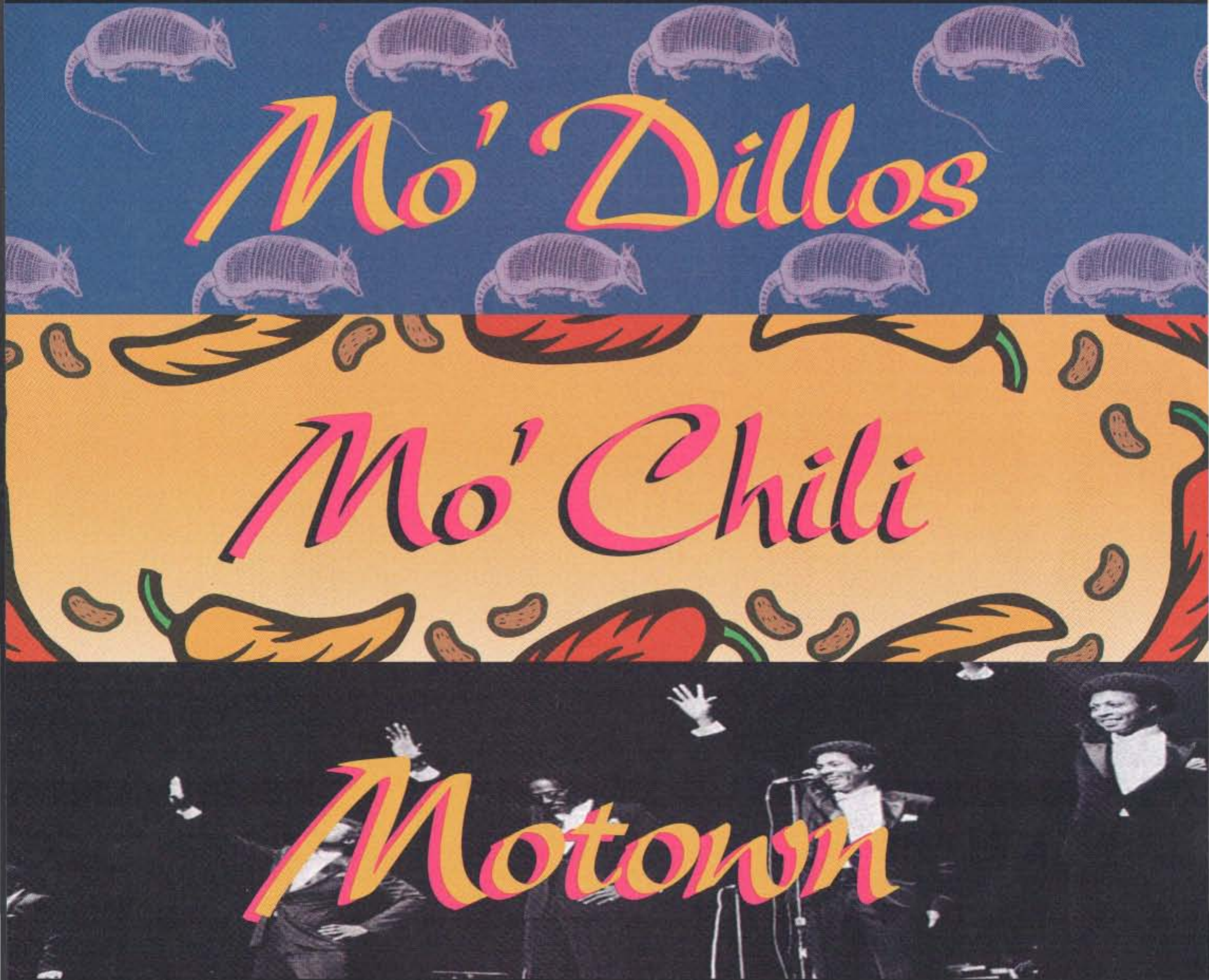

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livery mechanism.

SQL Server 6.0

Microsoft originally licensed an OS/2 version of SQL Server from Sybase. But when Microsoft ditched OS/2 for Windows NT, it terminated that business relationship. The latest version of SQL Server continues to look much like the Sybase database management products (which run on Unix platforms), but Microsoft says that it has changed about 60 percent of SQL Server. We found that the underlying architecture has changed considerably from prior versions. The programming interface and configuration process, on the other hand, are similar to earlier versions of both Microsoft SQL Server and the Sybase product.

COMPARING RELATIONAL DATABASE FEATURES

	DB2/2	ORACLE	SQL SERVER
Price per user (50 users) [1]	$123	$101	$25
Server platforms (with OS)	PC (OS/2), RS/6000 (AIX), AS/400 (OS/400), mainframe (MVS, VM)	PC (OS/2, NT, NetWare), assorted Unix, mainframe (MVS, VM)	NT
Client platforms	DOS, Windows, OS/2, Macintosh	DOS, Windows, OS/2, Macintosh	DOS, Windows [2]
RAM (replication enabled)	16 MB	16 MB	32 MB
Symmetric multiprocessing support	●	●	●
Maximum columns per table	256	256	250
Row locking	— [3]	●	— [3]
Replication	●	●	●
Centralized management	●	— [4]	●
Referential integrity	●	●	●
Stored procedures, triggers, and constraints	●	●	●
Programming languages	C, C++,COBOL, REXX, FORTRAN	C, C++, COBOL, FORTRAN	C, C++, COBOL, Visual Basic
Transport protocols	IPX, NetBIOS, SNA (APPC), TCP/IP	IPX, NetBIOS, TCP/IP	IPX, NetBIOS, TCP/IP
Static SQL	●	○	○
SNMP alerts	●	○	○

● = yes; ○ = no

[1] Includes base product plus 49 client licenses

[2] Microsoft does not support OS/2 and Mac clients, but third-party support is available.

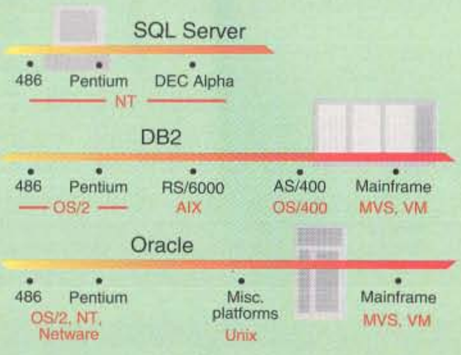
[3] Page-level only

[4] Oracle offers separate remote-monitoring utilities.

SQL Server, which now runs only under NT, has a new GUI administration tool called SQL Enterprise Manager (SEM). While previous versions of the RDBMS used a text-mode Interactive SQL (ISQL) interface, this one has GUI database-administration tools. New features include scrollable cursors, distributed management objects, and extended stored procedures. Before, you coded your SQL Server stored procedures in Microsoft's (Sybase's) Transact-SQL language, and you were limited both in performance and in function to the design of Transact-SQL. Extended stored procedures allow SQL Server to use external programs to handle database events. And, like Oracle, the program uses a cost-based optimizer to examine and reformat SQL statements.

Microsoft has tightly integrated SQL Server into the NT environment. It is consistently the same database manager, from both architectural and user interface viewpoints, on Intel, Mips, or DEC Alpha systems. NT schedules individual SQL Server threads on different CPUs if your database server is an SMP machine.

Moving On Up



While SQL Server runs only on Windows NT, DB2 scales from PCs up through mainframes. Oracle, which runs on more than 90 platforms, scales especially well.

SQL Server, like DB2/2 and Oracle, can automatically replicate changes onto remote databases, but its replication uses a publish-and-subscribe metaphor. A distribution server hosts a distribution database, which holds rows from published tables until SQL Server can copy the rows to the databases that subscribe to the published tables. A publication database can define publication tables, and a subscription database can subscribe to those published items. Through SQL Server's SEM interface, replication is particularly easy to set up. However, changes made on a remote SQL Server by means of a remote procedure cannot be rolled back (undone).

SQL Server's tight integration with NT helps make it a secure database, and SEM gives it point-and-click ease of use. But SQL Server isn't yet ready for the enterprise. If you use OS/2 or Macs, you'll have to buy an ODBC connectivity solution from a company other than Microsoft. And because of the rift between Microsoft and Sybase, SQL Server customers who want to mix the Sybase and Microsoft versions of the program will have trouble. ■

Contributing editor Barry Nance is the author of several books, including Using OS/2 Warp *and* Client/Server LAN Programming *(Que, 1994). You can reach him via the Internet at barryn@bix.com.*

Product Information

DB2/2 Client/Server 2.1 . . . .$1495
(includes five client licenses;
$85 per additional client)
IBM
Armonk, NY
(800) 342-6672
(914) 765-1900
fax: (313) 225-4020
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Oracle 7.1 . . . .$199 per server
($99 per client)
Oracle
Redwood Shores, CA
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fax: (415) 506-7200
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SQL Server 6.0 . . . .$999
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Microsoft
Redmond, WA
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(206) 882-8080
fax: (206) 936-7329
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Organization Made Loud and Clear

NetManage's ECCO Pro is both a sophisticated PIM and an alternative Windows desktop

JOHN MONTGOMERY

There *is* a method in your madness, you continue to insist, despite working in an office that seems to have been decorated by the guy who invented the Post-It, where the papers on your corkboard should be carbon-dated, and where any horizontal surface is a filing cabinet. This is entropy in action.

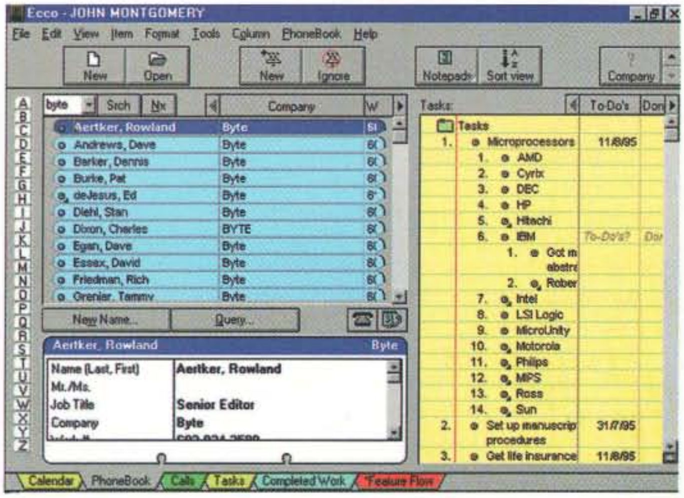
NetManage's ECCO Pro is a personal information manager (PIM) that fights entropy. By using linked outlines, ECCO not only can round up your to-do list, your list of people to call, and your phone book, it can help restructure the way you work. With ECCO, you'll start to think in hierarchical terms, categorizing what needs to be done and even doing simple project management.

But that's ECCO's downside, too. As with any PIM, *you* have to adjust to the way *it* works. Despite this one possible shortcoming, ECCO is powerful enough to handle most PIM tasks. Actually, ECCO is a little scary. It's so all-inclusive that you may find you can't function without it. You won't feel comfortable jotting a name down on a piece of paper. You'll have to enter it directly into ECCO's phone book.

Not Just a PIM

About three years ago, ECCO reintroduced PIM users to the concept of outlines. The new version (3.0) calls them notepads, but they're basically still outlines, with some user interface (UI) improvements, such as easy ways to join and split lines.

ECCO is capable of far more complex presentation and organization, though. You can add columns, as you can in a spreadsheet. For a project outline with a month-project-tasks hierarchy, you could add a start date and an end date, a pop-up list of people available to work on the project, and a check box to mark when you finish a stage of the project. If you wanted to get really fancy, you could even add Gantt charts and columns based on information in your phone book or to-do list. In fact, you can cross-reference the information in any of the outlines you create.



	Company	W
Aertker, Rowland	Byte	SI
Andrews, Dave	Byte	6(
Barker, Dennis	Byte	6(
Burke, Pat	Byte	6(
deJesus, Ed	Byte	6'
Diehl, Stan	Byte	6(
Dixon, Charles	BYTE	6(
Egan, Dave	Byte	8(
Essex, David	Byte	8(
Friedman, Rich	Byte	6(
Grenier, Tammy	Byte	8(

Aertker, Rowland Byte

Name (Last, First)	Aertker, Rowland
Mr./Ms.	
Job Title	Senior Editor
Company	Byte

Tasks:

Tasks	To-Do's	Don
1. Microprocessors	11/8/95	
1. AMD		
2. Cyrix		
3. DEC		
4. HP		
5. Hitachi		
6. IBM	To-Do's?	Do
1. Got m abstr		
2. Rober		
7. Intel		
8. LSI Logic		
9. MicroUnity		
10. Motorola		
11. Philips		
12. MIPS		
13. Ross		
14. Sun		
2. Set up manuscrip procedures	31/7/95	
3. Get life insurance	11/8/95	

Unlike standard Windows applications that are compliant with the Multiple Document Interface (MDI), ECCO Pro actually merges different views into one seamless window, so it's easy to move data from one notepad to another.

This type of cross-referencing is handy. You can drag information from one outline into another, and it will be referenced in both places. For example, drag a name from your phone book to your calls list. ECCO not only adds it there but adds a check mark by that name in the phone book to remind you to call the person. During the phone call, you can take notes under the person's name in either the calls list or the phone book. The name and note will appear in both places. When you mark the call as done, it's added to your completed tasks list, so you can keep a record for your nosy boss.

Learning How to Think

ECCO includes six templates, each targeted at a type of information: general, legal, manager, project, research, and sales. Common to each template are, not surprisingly, a calendar and a phone book—standard in any PIM. Common across most are a tasks list and a calls list.

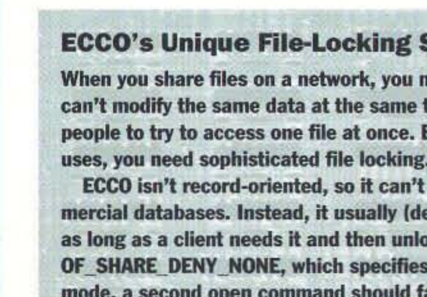
Outlines and templates aside, what makes ECCO special is its integration with other applications. It supports OLE 2.0, so you can embed documents into ECCO outlines with no problem (though in these days of widespread OLE 2.0 availability, that goes without saying). Beyond that,

TECHNOLOGY FOCUS

ECCO's Unique File-Locking System

When you share files on a network, you need some way to ensure that two people can't modify the same data at the same time. That's easy if you're not expecting two people to try to access one file at once. But with shared files, such as those ECCO uses, you need sophisticated file locking.

ECCO isn't record-oriented, so it can't use the type of locking found in most commercial databases. Instead, it usually (depending on the type of file) locks a file for as long as a client needs it and then unlocks it. This basic protocol is called OF_SHARE_DENY_NONE, which specifies that if the file is already open in another mode, a second open command should fail, but multiple clients can open it in this mode. When the file is open, ECCO sets the first 16 bytes of the file as locked using the DOS FLOCK function (a DOS INT 21H function). Once all this is set up, only the locking process can read or write to the file.



ECCO sets up locked "channels" to ensure that only one instance of each local file can attach to the shared file.

File locking varies a little depending on the type of file you're opening. The most common scenario would run like this. You open a shared file. ECCO opens the shared file itself, loads it into memory on your machine, and then closes it. ECCO then opens a pair of shared status files and holds them open until you close the original file.

What's New in Version 3.0

- **Group scheduling via direct network access, TCP/IP, and E-mail**
- **Real-world templates (e.g., Rolodex and three-ring binder)**
- **Expanded drag-and-drop functions**
- **Time and expense tracking**
- **Simplified dialog boxes**

ECCO also includes a clever tool called the Shooter—a sophisticated cut-and-paste tool that far surpasses Windows' own. When you install ECCO, the Shooter (a small arrow) appears in the title bar of all the applications you run. You left-click on it, and a drop-down menu appears, offering you the option of "shooting" selected information to another application. Generally, you'll probably be shooting names and addresses from your ECCO phone book into word processing documents.

Here's the best part: When you update the information in your ECCO phone book, it will be updated in your word processing document, too. We noticed a minor problem with the Shooter, however. On slow machines, it drags down the responsiveness of your running applications. But on any machine faster than a 486/50, you shouldn't notice a problem.

The main drawback to ECCO is that the database around which it's centered isn't fully relational, and the filtering engine can't compensate for this. So, to take different views of a project, you must create a new outline and drag the folders from the folder manager into the new outline. You can't click on a column in your existing outline and say, "view by this column." You can sort by columns, however.

Once you have mastered ECCO, you will probably find that your coworkers are envious of your newfound efficiency. That's when to install it on your network. ECCO uses three tools for sharing information. With the first tool, ECCO stores its shared files on a file server but keeps the executable file on your local disk. You then use the second tool—an E-mail transport such as Vendor-Independent Messaging (VIM) or MAPI—to request meetings. The third tool is replication. You can replicate local information from a desktop computer to a notebook and back.

Product Information

ECCO Pro 3.0 .... $175
NetManage, Inc.
ECCO Division
(206) 885-4272
fax: (206) 885-0127
eccoservice@netmanage.com
http://www.netmanage.com
Circle 1231 on Inquiry Card.

Enforced Organization

For people who are already organized, ECCO is a natural way to work. If you're not organized, ECCO can help you get there by making you think of projects and information hierarchically. But if your style is more free-form, maneuvering to the correct outline, finding the right place to enter data, and learning how to use the information in the various columns could be more trouble than it's worth. With that caveat, we recommend ECCO Pro for anyone who is striving to reach the apex of organization. ■

John Montgomery is BYTE's features editor. You can reach him on the Internet or BIX at jmontgomery@bix.com.

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Storming the Enterprise

OLE Automation servers make Visual Basic 4.0 a tool for three-tier client/server applications

STEVE GILLMOR

With release 4.0, Visual Basic developers can create their own OLE components, deploy them via Remote Automation technology, and programmatically control the development environment. Microsoft's new version offers other significant improvements to the existing Standard and Professional Editions, as well as adding an Enterprise Edition for team-based client/server projects. It's a big leap forward.

As Microsoft moves millions of computer users to the 32-bit world of Windows 95 and NT, Visual Basic has been endowed with both 16- and 32-bit versions. Now users can not only create NT and Windows 95 logo-ready applications, but they can use the same Visual Basic for Applications programming language that was first introduced in Microsoft Excel.

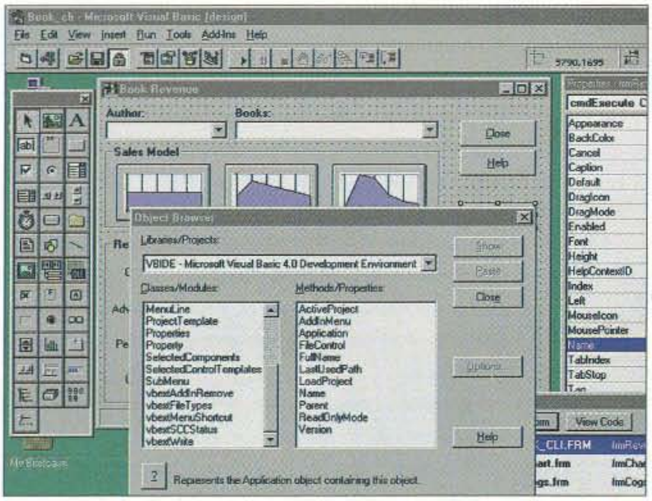
From 16-bit VBXes to 32-bit OCXes

Since version 1.0, Visual Basic has prospered by providing an intuitive development toolkit augmented with third-party Visual Basic custom controls (VBXes). Version 4.0 delivers a migration path from 16-bit VBXes to 16- and 32-bit OLE Controls (OCXes).

The conversion is automatic. Visual Basic checks to see if OCX updates exist when your project is loaded, and it then prompts you with a dialog box to confirm the changes. You can still use VBXes if you like, but only with the 16-bit versions of Visual Basic 4.0 provided in the Professional and Enterprise Editions. The Standard Edition is available only in the 32-bit version. All three editions ship with 10 Windows 95 custom controls.

Integration of the Data Control and the data-aware controls, which began with version 3.0, continues with the new product. The OLE Container Control now is databound, as are the grid, list, and combo boxes. A new 32-bit version of the Jet database engine, which Visual Basic shares with Microsoft Access, adds referential integrity, cascading updates and deletes, programmatic security control for users and groups, multiple workspaces for multiple simultaneous connections, and Rushmore technology for accelerated queries.

Version 3.0 of the Jet engine also marks Microsoft's first steps toward database replication; developers can now convert databases into replicable forms that can be copied and subsequently synchronized. If you have Access for Windows 95, you can synchronize (or merge) one replica with another via the Windows 95 Briefcase.



Visual Basic 4.0's Object Browser displays objects you create, as well as objects from other applications. Here objects are being selected from Visual Basic's own integrated development environment (IDE) library.

We were particularly pleased with Visual Basic's leveraging of the Windows 95 environment. For example, you need Windows 95's expanded Resources to load multiple instances of the program, a requirement for developing remote OLE servers on a local machine. Drag-and-drop and right-mouse quick-menu support (both Windows 95 features) quickly become old friends during forms development.

The Look and Feel of OLE

Like its predecessor, Visual Basic 4.0 lets you control other applications' objects via OLE Automation. You can use the enhanced OLE Container Control to display stored OLE documents, including audio and video clips. Commercial applications, such as Excel, Word, and Visio for Windows, can provide ToolBox icons to represent their OLE document objects.

The Visual Basic editor reflects the expanded integration of OLE Automation. You use the new Object Browser (see the screen) to explore the object libraries supplied by OLE-enabled applications. When an OLE server is installed on your system, you can select its object library from a drop-down list that also includes your current project. You then choose a class from the Classes/Module box, which displays the associated methods and properties in the companion window.

You can show or paste syntax templates into your code, jump to context-sensitive help, or simply use the Browser as a quick way to navigate from one spot to another in your project's code. You can also set an option to view either one procedure at a time or all in a scrollable listing.

OLE Automation and Other Developments

Microsoft is midway through the process of migrating the Visual Basic for Applications language across its Office suite; Office 95 now has it in Excel and Project, with Access to receive it soon, and Word and PowerPoint to follow by year's end. VBA has finally arrived, bringing with it optimized OLE tools such as the `With` and `For Each` statements and the `Collection` data type. These constructs make code simpler, faster, and more readable, plus you can use code generated by the Excel macro recorder without modification.

VBA allows conditional compilation both in code and from the command line, making it simple to create common code that can be recompiled for either 16- or 32-bit versions of projects. You can use the new Compile on Demand and Background Compile switches to determine whether a project is to be fully compiled before it starts, compiled as needed to speed application start-up, or compiled in the background during idle time. Support has been added for automatic incremen-

TECHNOLOGY FOCUS

Executing Remote Objects

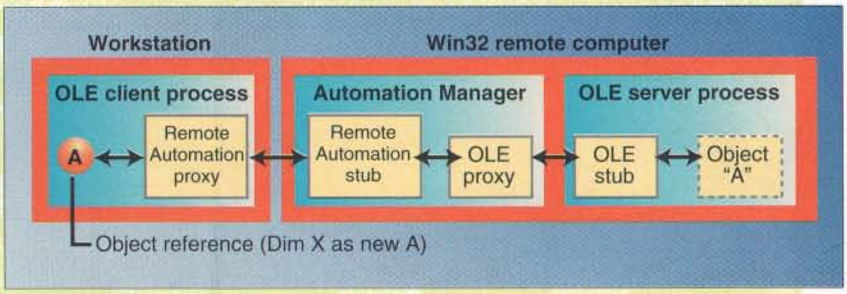
Visual Basic 4.0's technology for distributing and executing remote objects offers a glimpse of future Windows technology. Microsoft says these remote-execution features will be included as part of Cairo, the next major upgrade of Windows NT.

When you install the Enterprise Edition on a client machine, Visual Basic adds a new OLE Automation proxy. When an OLE client asks to use an object, the Windows Registry knows whether that object resides on a local or remote machine. If it's on a remote machine, the Registry communicates with the new OLE proxy, which converts the standard OLE Automation call to a Windows NT remote procedure call (RPC). The object is then sent across the network wire, where it's picked up by the Automation Manager, a multithreaded, redistributable application that the Visual Basic developer places on the server by using the Setup Wizard.

The Automation Manager receives the RPC message stream and reconverts (or *unmarshalls*) the data to standard OLE Automation calls, which are then sent to the server application. Neither the client nor the server deals with anything other than standard OLE Automation. In addition, the programmer doesn't need to know anything about RPC coding.

Because OLE servers created in Visual Basic are single-threaded, programmers tend to run several instances of the same object within a server to achieve multitasking. But since each object takes up roughly 500 KB of RAM, running multiple remote servers simultaneously can drag down performance. To get around this problem, Visual Basic provides a Pool Manager, which maintains pools of objects that can be handed to clients as needed. The pools can be on separate computers.

The Remote Automation technology works only with out-of-process servers. You cannot access a remote in-process DLL directly from a client machine, but the remote server can access those DLLs on its own machine.



Remote Automation works by replacing the original proxy and stub with modules that use the remote procedure call (RPC) protocol to communicate over the network.

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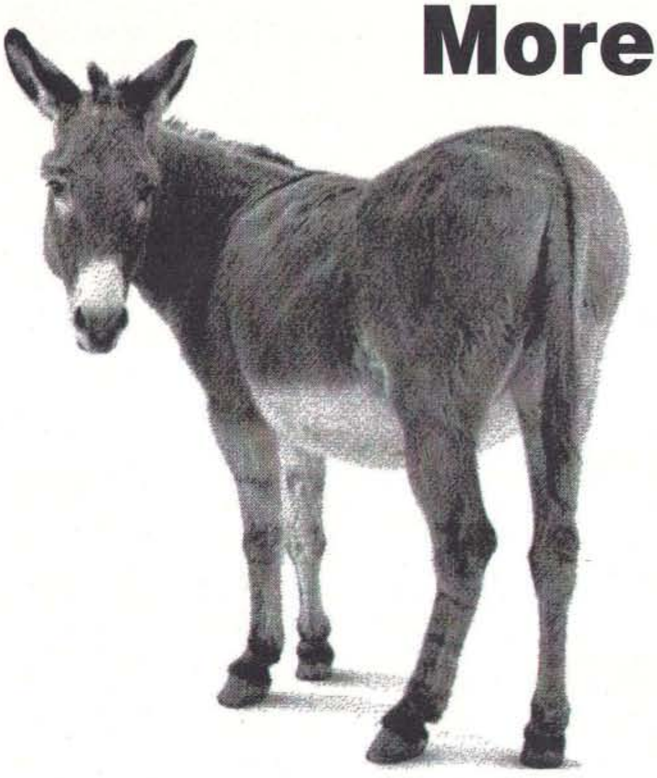

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tal versioning, and you can now edit and store Windows EXE header-file information (e.g., comments and trademarks).

The Professional Edition takes a giant step by offering the ability to create your own OLE Automation servers. Two types are possible: in-process and out-of-process. Both expose methods and properties that can be browsed by any OLE client application. An in-process server is implemented as a DLL and runs in the same process as the client that accesses it.

Out-of-process servers run in their own address space; they require OLE's proxy/stub mechanism to receive parameters from the client and then return them. The Enterprise Edition adds the capability of executing these out-of-process servers remotely over a network (see the Technology Focus box). You can move frequently changing code from front-end client machines to a centralized OLE Automation server for easier maintenance, while processor-intensive tasks are executed by powerful remote servers at the back end.

Visual Basic 4.0 is itself an OLE server, exposing its integrated development environment (IDE) to interaction with OLE-compatible applications, including OLE servers that you can now create. This technology opens Visual Basic to a variety of integrated add-ins, including Wizards, template libraries, forms generators, CASE, and team development tools.

A Promising Future

Visual Basic 4.0 continues to expand the horizons for custom applications. Wholesale adoption of OLE Automation throughout the programming system goes hand in hand with Microsoft's Office 95 strategy. Gone are the synchronization issues with Microsoft Access that required reduced-functionality compatibility layers.

The ability to create OLE Automation servers is not matched in OCXes; that task still falls to Microsoft Visual C++ or comparable tools. Visual Basic continues to generate code that requires a run-time interpreter for execution, with a resulting trade-off in performance versus a compiled product. On the other hand, Visual Basic executables remain smaller, because they don't have to add run-time code for each module in a distributed application.

Furthermore, the Remote Automation technology does not constitute true, distributed-component computing. Rather, it supports a new approach to rapid applications development for client/server tools. Because business rules are separated from the front and back ends, the resulting code can be revised, maintained, and reused more easily. And the new OLE-server capability can make users providers—not just consumers—of Visual Basic applications and add-ins. ■

Steve Gillmor is director of Southern Digital, Inc., a consulting firm in Charleston, South Carolina. He is coauthor of Using Visual Basic 3 *(Que/Prentice-Hall, 1993). He can be reached on the Internet at sgillmor@aol.com or on BIX c/o "editors."*

Product Information

Visual Basic 4.0
Enterprise Edition $995
(Standard Edition, $99; Professional Edition, $499)
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In the 1994 Reliability Ratings Survey, the BEST Fortress customer satisfaction/reliability score was higher than any other (UPS) vendor surveyed – 4.94 average rating on a 1-to-5 scale. All surveyed would buy BEST again.

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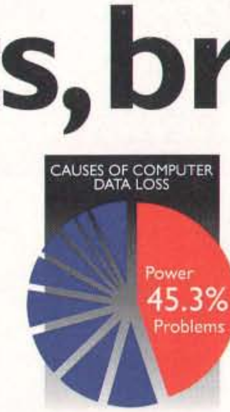
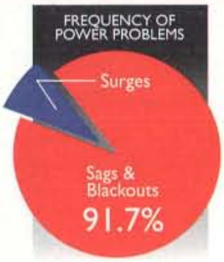
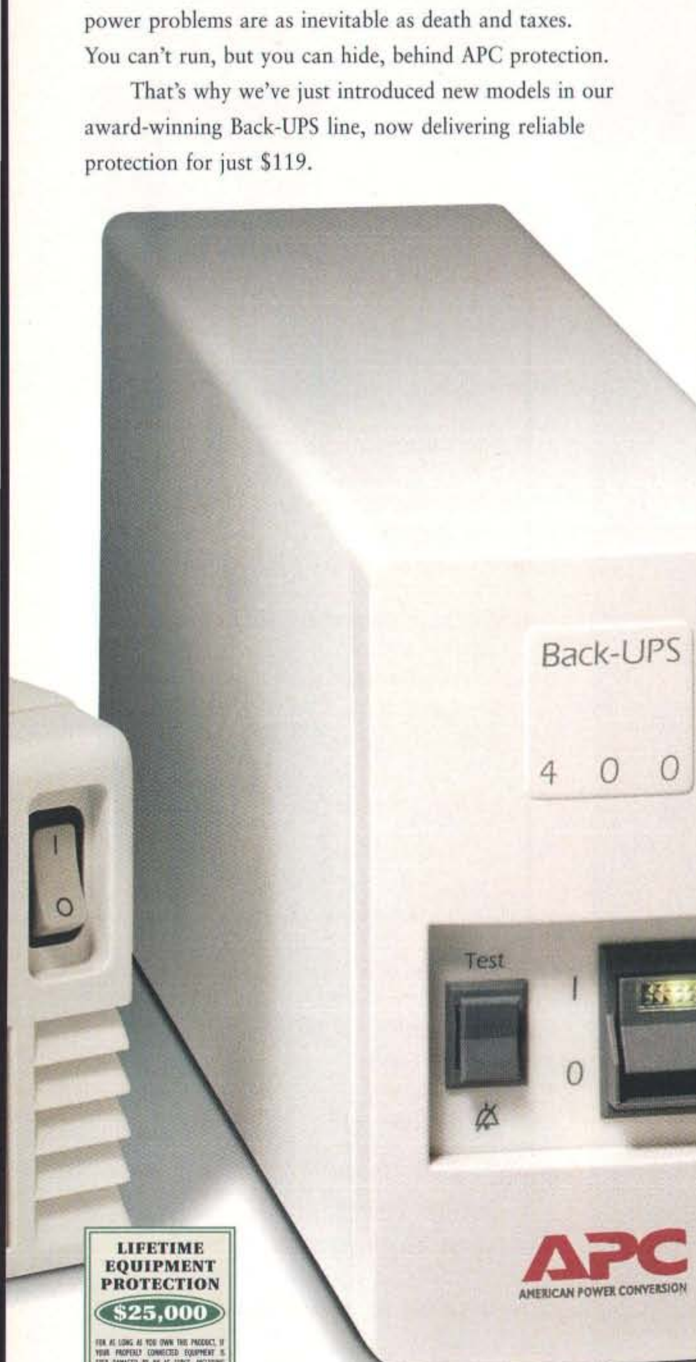
That's why we've just introduced new models in our award-winning Back-UPS line, now delivering reliable protection for just $119.



Source: Contingency Planning



Source: Bell Laboratories



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FOR AS LONG AS YOU OWN THIS PRODUCT, IF YOUR PROPERLY CONNECTED EQUIPMENT IS EVER DAMAGED BY AN AC SURGE, INCLUDING SURGES DUE TO LIGHTNING, APC WILL REPAIR OR REPLACE OUR PRODUCT AND UP TO $25,000 OF CONNECTED EQUIPMENT (SEE POLICY FOR DETAILS, VALID IN U.S. AND CANADA ONLY).

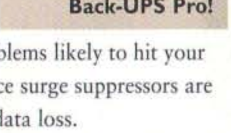
IN THE NEXT THREE MONTHS, MORE THAN 30,000,000 PCS WILL BE HIT BY POWER PROBLEMS...

Who needs power protection? If you use a computer, you do. A study in a recent *PCWeek* showed that the largest single cause of data loss is bad power, accounting for almost as much data loss as all other causes combined. Every PC plugged into an outlet is vulnerable. In fact, you have better odds of winning the lottery than of escaping the sting of power problems. One study found a typical PC is hit over 100 times a month, causing keyboard lockups, hard drive damage, and worse.

Simply put, if power problems are the least of your troubles, you've got one chance to keep it that way. You insure your car and home with the best policy you can afford. It just doesn't make sense to leave your PC (which is at far greater statistical risk) vulnerable to loss or damage.

WHY A $119 APC UPS COSTS LESS THAN A $9.99 "SURGE PROTECTOR"...

Contrary to most people's belief, a PC alone already has more protection built into it than a low-end "surge suppressor," which is usually nothing more than a well-packaged extension cord. In other words, going without any protection is just as good as underspending on one of the most important PC decisions you'll make.



For extended brownout protection for advanced PC workstations call about APC's New Back-UPS Pro!

And since sags and blackouts represent more than 90% of power problems likely to hit your computer, even quality, high-performance surge suppressors are literally powerless to protect you from data loss.

That's why you need instantaneous battery backup power from an APC Uninterruptible Power Supply to prevent

PC World Top 20 Upgrade

"Don't take chances. Get the ultimate protection... from APC." --PCWorld

"★★★★ *Back-UPS should be standard on every desktop... effective, affordable, designed to last..."* --PC Computing

"A UPS can pay for itself the first time it saves your data." --MacUser

PC MAGAZINE UK EDITORS' CHOICE

"The clear winner in price performance... it's unbeatable..." --PC Magazine UK

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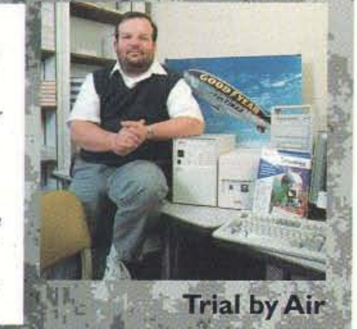
protection against
and other trials by fire

More than 3,000,000 satisfied customers count on APC reliability that goes above and beyond the call of duty

After a raging fire which took 18 trucks to subdue, Michael Benolkin, director of the Systems Division at Correa Enterprises, Inc. didn't expect much. "While rummaging through the ashes, we heard something beeping. Our four APC units were still in action, while two UPSes from another brand were history. We're still using these same APC units at our new office location - they still work like a charm! We're impressed with the ruggedness, reliability, and product support offered by APC."

Trial by Fire

Brian Krause, Network Manager for Goodyear Airship Operations, knows how critical APC protection can be." The night of the All-star game a tornado came through our blimp hanger and took out our roof. Our airships demand absolute communication so I protect our local and remote servers with the most reliable protection I can find: APC. APC's PowerChute software shut our server down in an orderly way... closed out all files nice and neatly. When we reconnected, everything came back up perfectly, without a hitch."

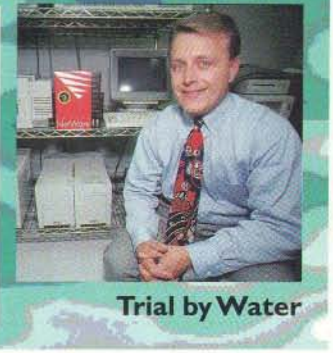


Trial by Air

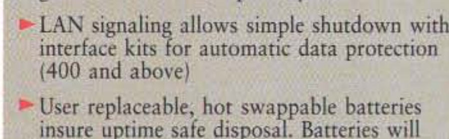
Doug Welch learns his reliability lessons well: "While still a Computer Science student, I was at home preparing a large spreadsheet for a final project when Anchorage experienced an all too common 5+ Richter earthquake. If not for my Back-UPS 400 it would have been back to square one! I'm now the Network Systems Manager at Charter College, in charge of three networks. I learned my UPS lesson well back in my student days. I've never been disappointed with APC and the product has had quite a work out."

Trial by Earth

Faced with a water main break, Mark Conley, Regional Manager of Novell's remote sales office in Detroit was amazed at APC's reliability. "The APC unit was sitting in an inch and a half of water, working just fine, as though nothing was unusual and we lost no data to this disaster. We've used APC here now for at least four years - more than a dozen units are all around the office, and we're well satisfied, so we were even more impressed to learn that the units are amphibious!"



Trial by Water



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- $25,000 lifetime Equipment Protection
- 10 minute runtime with specified applications. For longer runtimes choose next largest unit.

Model	Application	Sugg.List
200 **NEW**	"Green" PCs	$119
280 **NEW**	LAN Nodes	$139
400	Desktop 486/386 systems	$199
450	Tower 486/386 systems	$254
600	CAD/CAM workstations	$359
900	Longer runtime	$529
1250	Multiple systems	$689

keyboard lockups, data loss, and crashes. With an APC UPS, you get six times the protection of a high-end surge protector for little more than twice the price. And $119 is much less expensive than false peace of mind. APC UPSs carry up to a $25,000 lifetime guarantee against surge damage to your properly connected equipment, and are available to suit any application, from network servers and PCs, to fax and satellite systems.

PROTECT YOURSELF OR KICK YOURSELF...

It's been said that there are two types of computer users: those who have lost data, and those who are about to. Prevent the single largest cause of computer problems and join a fast-growing third category: those who protect their PC's with the most reliable protection they can buy: APC UPSes. So ask for APC at your favorite reseller. At just $119 an APC UPS is serious protection no serious computer user should be without.

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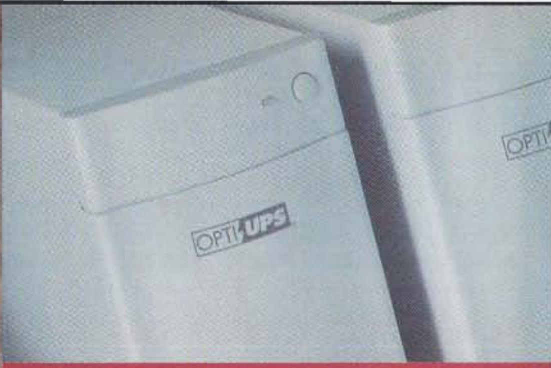
The most protection less money can buy.

MODEL	OPTI-UPS 280E	APC BK280	APC BP280	TRIPP LITE BC280	TRIPP LITE OMNIPRO280	TRIPP LITE SMART280
Price*	$139	$139	$199	$137	$194	$295
VA	280	280	280	280	280	280
Type	Line Interactive	Standby	Line Interactive	Standby	Line Interactive	Line Interactive
Voltage Regulation	Buck & Boost	None	Buck & Boost	None	Buck & Boost	Buck & Boost
Intelligent Comm. Port	Yes	No Port	No Port	No Port	No Port	Yes
Data Line Protection	Yes	No	Yes	No	No	No
User Replaceable Battery	Yes	Yes	Yes	No	No	No
Auto Self Test	Yes	No	Yes	No	Yes	Yes



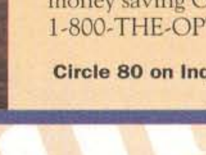
The OPTI-UPS 280E has more features yet costs less than the APC 280 Back-UPS Pro or Tripp Lite Smart 280.

(*Why pay more to get less?*)

The OPTI-280E is part of our power-packed E-Series, which also includes the 420E, 650E, 1000E and 1400E. It offers the high-end features you need like buck and boost line conditioning, a smart communications port and compatibility with our OPTI-SAFE+ UPS Communication Software. The bottom line is that the OPTI-UPS E-Series offers more than basic protection and still costs over $60 less than the comparable APC or Tripp Lite unit!

Don't allow yourself to be under-protected by 'value-of-data' charts and graphs. The OPTI-UPS E-Series has been designed with the idea that everyone's data is equally important and deserves the highest level of protection available. Designed for network and stand-alone use, the OPTI-UPS E-Series provides guaranteed security from power blackouts, surges, sags, and other destructive electrical disruptions.

OPTI-UPS $25,000 GUARANTEE LIFE INSURANCE FOR COMPUT



It's never been easier to get the most protection less money can buy. For more information on the money saving OPTI-UPS E-Series simply call 1-800-THE-OPTI; Product Code 519.

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Sudden Darkness

BYTE tests 31 network-capable UPSes and picks the best

REX BALDAZO, RICK GREHAN, AND DAVE ROWELL

Deciding that your network servers need power protection is easy. Choosing an uninterruptible power supply (UPS) to protect them is not.

At the very least, you'll want a UPS that can automatically and gracefully shut down servers without data loss during a power outage. The ability to run through brownouts is important in some locations, and any UPS should filter out voltage transients (e.g., spikes, surges, and noise) that can damage data or equipment.

Before you buy, however, you should consider many other factors, such as local power conditions, equipment load, network topology, business dependency, budget, and even your style of system administration. To help simplify your decision, we tested 31 such network-capable UPSes with capacities between 750 and 1250 volt-amperes—enough to comfortably support two to three file servers. Prices ranged from $600 to $2050.

We evaluated hardware performance and network software features. In most cases, all 31 units can do the job, but some better than others. Weighing output quality, software functionality, battery life, and price, we wholeheartedly recommend seven of these units (see the photo at right). To help you decide which is best for your needs, see our feature-comparison table that begins on page 228.

DENNIS WARNESKY © 1995

The network UPSes we'd recommend most. For on-line units (back row, left to right): Powercom's ONL-1250, Exide Electronics' Powerware Prestige 1000P-1, Controlled Power's LT-1200, Powercom's ONH-1000, and Hewlett-Packard's PowerWise 1000 VA UPS. For line-interactive units (paired in front): Deltec's PowerRite Pro 1000VA and American Power Conversion's Smart-UPS 1000.

Line Interactive or On-line

UPSes suitable for backup of small server installations come in two classes: line-interactive units and on-line units (the latter tend to cost more).

The main distinction between line-interactive UPSes and on-line UPSes, practically speaking, is what happens to output voltage at the moment of a power loss. A line-interactive unit lets through a small and usually inconsequential power gap (measured in milliseconds as a *transfer time*) when it switches to battery power during an outage.

Line-interactive units are basically high-class standby UPSes that have microprocessors, some voltage regulation, better performance characteristics, and a greater ability to communicate with software on a server, usually through a serial connection. (We didn't test standby UPSes with lesser capabilities.)

A typical on-line UPS constantly converts AC to DC and then back to AC again, and a power outage (or just about any other power abnormality) has little or no effect on output. Most PC power supplies, especially server-quality units, can easily withstand voltage dropouts of 20 milliseconds, and sometimes longer, without consequence. The longest transfer time we measured from a line-interactive UPS was 15 ms (see the comparison table). Some electronic equipment may not tolerate any transfer time, and touchy power supplies in some older PCs might reboot with transfer times as short as 5 ms, but these are not typical situations on most networks.

Quality of voltage regulation is perhaps a more important difference between the two classes. On-line UPSes produce a nearly constant, purely sinusoidal voltage between 115 VAC and 120 VAC regardless of input voltage. Line-interactive units pass utility power directly through to their output receptacles, although with noise filtering and surge suppression. As a result, output voltage rises as input voltage does. At a lower-threshold voltage, and usually at an upper-threshold voltage, the UPS switches to battery power.

To extend its operational voltage range and reduce variations in output voltage, a line-interactive design uses a transformer that boosts low voltages and often trims (or bucks) high voltages (see the text box "Boost and Buck" on page 231). One result is that a line-interactive UPS can power through extended periods of low utility voltage (i.e., brownouts). The line-interactive units from American Power Conversion (APC), Deltec, Superior Electric, and Tripp Lite can also tolerate overvoltage as high as 140 VAC because they trim input voltages around 125 VAC or above (see "Boost/buck trigger levels" in the feature-comparison table).

The power supplies in most computers can operate over a wide range of AC voltages, generally 102 V to 132 V, but running long-term near either end of the range shortens operating life. If power in your area is consistently high or low, an on-line unit makes sense.

COMPARISON OF UPS MODELS TESTED

BLUE = HIGHLY RECOMMENDED
RED = HONORABLE MENTION

	MODEL	PRICE	CAPACITY (VOLT AMPS)	PRICE PER VOLT AMP	TAKES EXTERNAL BATTERIES	REMOTE TURN-ON OPTION	SNMP HARDWARE OPTION	WARRANTY[1]	WEIGHT (LBS.)	SOFTWARE TESTED (NETWARE/WINDOWS NT)
Line-Interactive Systems										
Acme Electric	SM 800	$799	800	1.00	○	●	○	2 years, incl. batteries; 5 years transformers	45	PowerMon II/PowerMon II
American Power Conversion	Smart-UPS 1000	$769	1000	0.77	○	●	internal	2 years; $25,000 load protection	42	PowerChute Plus/PowerChute Plus
Best Power	Fortress LI 1020B	$799	1020	0.78	●	●	external	2 years, $25,000 load protection	45	CheckUPS/Windows NT
Clary	OnGuard LI-1000	$849	1000	0.85	○	●	external	2 years	49	Data Save Plus 7.0/Data Save Plus 3.5
Deltec Electronics	PowerRite Pro 1000VA	$699	1000	0.70	●	software only	external	60-day money-back, 10 years, prorated after 2 years, $25,000 load protection	54	LanSafe III/LanSafe III
Hewlett-Packard	PowerWise UPS L900VA	$649	900	0.72	○	○	○	2 years, next-day exchange	48	PowerWise Assistant/PowerWise Assistant
International Power Technologies	I-UPS 1250	$899	1250	0.72	○	●	external	5 years, battery pro-rated after 3 years, unlimited load protection	55	IPT-Vision/IPT-Vision
Liebert	UPStation D	$972	900	1.08	○	●	internal	2 years, $25,000 load protection	45	SiteNet 2/SiteNet 1
Oneac	ON900A	$949	900	1.05	○	●	external	5 years; 2 years battery	64	MopUPS-RM/Windows NT
Para Systems	Minuteman Alliance A1250	$689	1250	0.55	○	○	external	2 years, $25,000 load protection	50	Network Manager II/Windows NT
Para Systems	Minuteman Powermind PML1250	$879	1250	0.70	○	●	external	2 years, $25,000 load protection	49	LanMaster/Windows NT
Powercom America	UPS 1200-A	$599	1200	0.50	●	software only	external	2 years, parts; 1 year labor and battery	59	Power Mon II/Power Mon II
Square D-EPE	Topaz SV 1200	$999	1250	0.80	●	software only	external	2 years	51	Merlin-Gerin UPS Manager/ Windows NT
Superior Electric	Stabiline SL 1000	$695	1000	0.70	○	○	external	2 years	50	Power Mon II/Power Mon II
Tripp Lite Manufacturing	Smart 1050	$664	1050	0.63	○	●	external	2 years, $50,000 load protection	32	PowerAlert Plus/PowerAlert Plus
Upsonic	LAN 100	$699	1000	0.70	●	●	external	4 years; 2 years battery; $25,000 load protection	64	UPSaver/Windows NT
On-Line Systems										
Alpha Technologies	CFR 1000	$1649	1000	1.65	●	○	external	2 years, in-the-field warranty adds labor costs	93	AlphaNet C/Windows NT
Best Power	Ferrups 1.15	$1789	1150	1.56	●	●	external	2 years, $25,000 load protection	126	CheckUPS/Windows NT
C-Power Products	Guardian CPG-750	$1255	750	1.67	●	●	external	5 years electronics; 3 years batteries	57	PowerEdge/Windows NT
Controlled Power Company	LT-1200	$1165	1200	0.97	●	●	external	1 year	108	PowerMon II/PowerMon II
Exide Electronics	Powerware Prestige 1000P-1	$889	1000	0.89	●	●	external	2 years	28	OnliNet/OnliNet
Hewlett-Packard	PowerWise 1000 VA UPS	$1099	1000	1.10	●	through software	internal	2 years; next-day exchange	48	PowerWise Assistant/PowerWise Assistant
IntelliPower	Bright-UPS IQ 1100	$1099	1100	1.00	●	●	external	1 year	38	PowerEdge 1.1/PowerMon II
Liebert	UPStation GX	$1485	1000	1.49	●	●	internal	2 years, $25,000 load protection	71	SiteNet 2/SiteNet 1
Para Systems	Continuous Power CP1K	$1399	1000	1.40	●	●	external	2 years, $25,000 load protection	50	LanMaster/Windows NT
Powercom America	ONH-1000	$969	1000	0.97	●	software only	external	2 years, parts; 1 year labor and battery	55	Power Mon II/Power Mon II
Powercom America	ONL-1250	$1095	1250	0.88	●	software only	external	2 years, parts; 1 year labor and battery	114	Power Mon II/Power Mon II
Square D-EPE	Topaz SX 900	$1390	900	1.54	●	●	external	2 years	60	Merlin-Gerin UPS Manager/ Windows NT
Toshiba International	1400S Series 1000VA	$2049	1000	2.05	●	●	external	3 years on-site (includes battery), 4-hour response	70	PowerMon II/Windows NT
Tripp Lite Manufacturing	Unison MPS 1200	$1399	1200	1.17	○	●	external	2 years, $100,000 load protection	58	PowerAlert/Windows NT
Upsonic	System 100	$999	1000	1.00	●	●	external	10 years, 1 year on-site with 2-day response, 2 years for battery	51	UPSaver/Windows NT

● = yes ○ = no

[1] Load protection pays for surge and lightning damage to load equipment; days are business days.

[2] All software for the UPSes we tested can shut down the server, alert workstations on the network, and log blackouts.

Some line-interactive UPSes, while running on battery power, produce output that is nicely sinusoidal (it costs more to do), but many units create just a rough approximation (a stepped square wave) that is tough to digest for some equipment. Fortunately, your servers need use it only during a controlled shutdown.

An on-line UPS can offer power factor correction—circuitry that reduces the "spiking" effects of the switching power supplies used in computers so that they draw less current from the wall (and you can run more equipment). An on-line UPS also has a higher crest factor (i.e., the ability to take a short surge of current much higher than it's rated for, typically 3 to 1) than that of line-interactive units (often just 2 to 1); thus, they can better handle the surge that occurs when computers are first turned on.

The typical on-line UPS's disadvantages are equipment cost, lower power efficiency (its rectifier and inverter constantly run), and heat production, which requires a fan. A line-interactive UPS costs less because of its simpler design, so it's less expensive to manufacture. A line-interactive UPS runs more efficiently because power is usually just passing through. And a line-interactive unit generates little heat because no real circuitry is active.

For mission-critical applications, you will probably want the reassurance of

SOFTWARE FEATURES[2]						HARDWARE TESTING RESULTS					
SOFTWARE RATING (1-5)	SHOWS BATTERY CHARGE OR RUN TIME	SHOWS UPS TEMPERATURE	SHOWS WEAK BATTERY	PERFORMS UPS DIAGNOSTIC TEST	DOES SOFTWARE UPS SHUTDOWN	SUPPORTS MULTIPLE SERVERS[3]	BATTERY RUNDOWN TIME (MINUTES), 70% LOAD	BATTERY SWITCH POINTS (VAC); LOW/HIGH[5]	BOOST/BUCK TRIGGER LEVELS (VAC)	TOTAL HARMONIC DISTORTION (PERCENT); NORMAL/ON BATTERY	TRANSFER TIME/ AVERAGE WORST CASE
2.5 / 2.5	○/○	○/○	●/●	○/○	○/○	●/●	4.0	90/132	102/none	3.4 / 14.5	4.3 / 5.0
5.0 / 5.0	●/●	●/●	●/●	●/●	●/●	●/●	6.0	99/146	102/130	1.7 / 6.8	3.2 / 5.6
3.0 / 2.5	●/○	●/○	○/○	○/○	●/●	●/●	5.5	94/135	108/none	2.7 / 8.8	—[7] / 7.2
3.0 / 3.0	●/●	○/○	●/●	●/●	●/●	●/○	6.0	95/137	105/none	2.2 / 14.0	5.5 / 5.8
4.0 / 4.0	●/●	○/○	●/●	●/●	●/●	●/●		97/144	108/127	1.5 / 9.0	3.0 / 3.4
5.0 / 5.0	●/●	●/●	●/●	●/●	●/●	●/●	10.5	93/131	102/none	1.7 / 3.4	9.3 / 12.0
3.0 / 3.0	●/●	○/○	●/●	●/●	●/●	●/●	6.0	92/134	113/none	2.3 / 8.7	5.5 / 5.8
5.0 / 2.5	●/○	●/○	●/○	●/○	●/○	●/●	5.5	88/131	102/none	3.6 / 11.3	4.7 / 6.5
2.5 / 2.5	○/○	●/○	●/○	●/○	●/○	●/●	6.0	87/140	103/none	4.8 / 52.2	10.8 / 5.0
3.0 / 2.5	○/○	○/○	●/○	●/○	●/○	●/●	4.5	93/131	103/none	1.9 / 34.0	3.3 / 5.6
3.0 / 2.5	●/○	●/○	●/○	●/○	●/○	●/●	7.0	98/138	104/none	2.1 / 3.5	8.7 / 12.4
2.5 / 2.5	○/○	○/○	○/○	○/○	●/●	●/●	7.5	90/135	105/none	4.4 / —[6]	2.6 / 5.6
3.5 / 2.5	●/●	○/○	●/○	●/○	●/○	●/○	7.5	93/130	101/none	2.2 / 3.7	9.3 / 12.3
2.5 / 2.5	●/●	○/○	●/●	●/●	●/●	●/●	14.0	97/142	108/128	3.2 / 7.0	3.8 / 5.4
4.0 / 4.0	●/●	●/●	●/●	●/●	●/●	●/●	10.0	86/139	110 and 101/126	1.7 / 30.2	4.7 / 5.8
3.5 / 2.5	○/○	●/○	●/○	●/○	●/○	●/○	4.0	85/133	117/118	2.1 / 2.5	5.6 / 6.2
2.5 / 2.5	○/○	○/○	●/○	○/○	●/○	●/●	8.0	92/139	N/A	12.9 / 12.6	N/A
3.0 / 2.5	●/○	●/○	○/○	○/○	●/●	●/●	8.0	87/>140	N/A	7.2 / 7.5	N/A
2.5 / 2.5	●/○	○/○	●/○	●/○	●/○	●/○	10.0	86/>140	N/A	5.6 / 5.9	N/A
2.5 / 2.5	○/○	○/○	●/●	●/●	●/●	●/●	18.0	84/138	N/A	7.3 / 8.1	N/A
3.0 / 3.0	●/●	●/●	●/●	●/●	●/●	●/●	9.0	94/>140	N/A	2.9 / 2.9	N/A
5.0 / 5.0	●/●	●/●	●/●	●/●	●/●	●/●	7.0	88/>140	N/A	3.7 / 3.6	N/A
2.5 / 2.5	○/○	○/○	○/○	○/○	○/○	●/●[4]	6.0	91/>140	N/A	5.1 / 5.9	N/A
5.0 / 2.5	●/○	●/○	●/○	●/○	●/○	●/●	8.0	90/>140	N/A	3.6 / 3.7	N/A
3.0 / 2.5	●/○	●/○	●/○	●/○	●/○	●/●	6.5	90/>140	N/A	4.9 / 4.8	N/A
2.5 / 2.5	○/○	○/○	○/○	○/○	●/●	●/●	12.0	78/>140	N/A	3.8 / 3.8	N/A
2.5 / 2.5	○/○	○/○	○/○	○/○	●/●	●/●	14.0	80/>140	N/A	3.9 / 4.9	N/A
3.5 / 2.5	●/●	●/○	●/○	●/○	●/○	●/○	10.0	80/>140	N/A	1.5 / 1.4	N/A
2.5 / 2.5	○/○	○/○	○/○	○/○	○/○	●/●	9.5	<75/>140	N/A	3.3 / 3.4	N/A
2.5 / 2.5	○/○	○/○	○/○	●/○	○/○	●/○	8.0	91/>140	N/A	2.7 / 2.7	N/A
3.5 / 2.5	○/○	●/○	●/○	●/○	●/○	●/○	9.5	89/138	N/A	4.6 / 6.1	N/A

N/A = not applicable.

[3] Under Windows NT, UPS requires cabling option.

[4] Up to two servers

[5] With most on-line units, we did not test above 140 VAC.

[6] THD difficult to measure; modified square wave.

[7] Transition times too variable to measure; sometimes none, sometimes up to 7.2 ms.

cleaner, more regular power, which you get from an on-line UPS. For most ordinary networks, line-interactive units are adequate.

Applying the Volts

Our hardware testing yielded few surprises from any of the UPSes; results were generally in agreement with vendor specifications. We used a California Instruments AC power source to drive varying voltages into each UPS and to test how well each handled low- and high-voltage conditions. With a BMI 3060 PowerProfiler, we accurately measured voltages going into and coming out of the UPS under test. The BMI also measured total harmonic distortion (THD) of output, a gauge of how far the output waveform diverges from sinusoidal (a low percentage is good; 25 percent is getting squared off). We judged the THD that a UPS produces on battery power as a significant measurement of quality.

To simulate power failures, we shorted the power source's output with a switch. That operation triggered a Tektronix TD5410A digital-storage oscilloscope with which we observed UPS output waveforms and, for line-interactive units, measured transfer times. We ran 10 trials for each UPS, more if the waveform was noisy, which nonsinusoidal output tended to be in the cycles just after transfer to battery.

After charging a UPS overnight, we

FOR MORE INFORMATION ON UPS MODELS TESTED

BLUE = HIGHLY RECOMMENDED RED = HONORABLE MENTION	MODEL	LOCATION	PHONE	INQUIRY NUMBER
Line-Interactive Systems				
Acme Electric	SM 8001	Cuba, NY	(800) 325-5848; (716) 928-2400	1150
American Power Conversion	**Smart-UPS 1000**	**West Kingston, RI**	**(800) 800-4272; (401) 789-5735**	**1151**
Best Power	**Fortress LI 1020B**	**Necedah, WI**	**(800) 356-5794; (608) 565-7200**	**1152**
Clary	OnGuard LI-1000	Monrovia, CA	(800) 442-5279; (818) 359-4486	1153
Deltec Electronics	**PowerRite Pro 1000VA**	**San Diego, CA**	**(800) 854-2658; (619) 291-4211**	**1154**
Hewlett-Packard	PowerWise UPS L900VA	Rockaway, NJ	(800) 533-1333; (201) 627-6400	1155
International Power Technologies	I-UPS 1250	Orem, UT	(800) 944-0356; (801) 224-4828	1156
Liebert	UPStation D	Columbus, OH	(800) 877-9222; (614) 888-0246	1157
Oneac	ON900A	Libertyville, IL	(800) 327-8801; (708) 816-6000	1158
Para Systems	Minuteman Alliance	Carrollton, TX	(800) 238-7272; (214) 446-7363	1159
Para Systems	Minuteman Powermind PML1250	Carrollton, TX	(800) 238-7272; (214) 446-7363	1159
Powercom America	UPS 1200-A	Placentia, CA	(800) 666-8931; (714) 632-8889	1160
Square D-EPE	Topaz SV 1200	Costa Mesa, CA	(800) 344-0570; (714) 557-1636	1161
Superior Electric	**Stabiline SL 1000**	**Bristol, CT**	**(800) 787-3532; (203) 585-4500**	**1162**
Tripp Lite Manufacturing	Smart 1050	Chicago, IL	(312) 755-5400	1163
Upsonic	LAN 100	Viejo, CA	(800) 877-6642; (714) 448-9500	1164
On-Line Systems				
Alpha Technologies	CFR 1000	Bellingham, WA	(360) 647-2360	1165
Best Power	Ferrups 1.15	Necedah, WI	(800) 356-5794; (608) 565-7200	1152
C-Power Products	Guardian CPG-750	Rockwall, TX	(214) 771-4303	1166
Controlled Power Company	**LT-1200**	**Troy, MI**	**(800) 521-4792; (810) 528-3700**	**1167**
Exide Electronics	**Powerware Prestige 1000P-1**	**Raleigh, NC**	**(800) 554-3448; (919) 872-3020**	**1168**
Hewlett-Packard	**PowerWise 1000 VA UPS**	**Rockaway, NJ**	**(800) 533-1333; (201) 627-6400**	**1155**
IntelliPower	Bright-UPS IQ 1100	Irvine, CA	(714) 587-0155	1169
Liebert	UPStation GX	Columbus, OH	(800) 877-9222; (614) 888-0246	1157
Para Systems	Continuous Power CP1K	Carrollton, TX	(800) 238-7272; (214) 446-7363	1159
Powercom America	**ONH-1000**	**Placentia, CA**	**(800) 666-8931; (714) 632-8889**	**1160**
Powercom America	**ONL-1250**	**Placentia, CA**	**(800) 666-8931; (714) 632-8889**	**1160**
Square D-EPE	**Topaz SX 900**	**Costa Mesa, CA**	**(800) 344-0570; (714) 557-1636**	**1161**
Toshiba International	**1400S Series 1000VA**	**Houston, TX**	**(800) 231-1412; (713) 466-0277**	**1170**
Tripp Lite Manufacturing	**Unison MPS 1200**	**Chicago, IL**	**(312) 755-5400**	**1163**
Upsonic	System 100	Aliso Viejo, CA	(800)-877-6642; (714) 448-9500	1164

connected it to enough computer equipment to create a load that was around 75 percent of its rated capacity. Starting with a 115-VAC input, we lowered the voltage into the UPS in 5-V increments, observing output voltages at each step. We noted where taps changed on line-interactive units and where battery power kicked in on all units. We repeated the same procedure in the other direction, going from 115 VAC to 140 VAC and sometimes further.

All the UPSes showed a built-in hysteresis when returning from battery power. If a UPS kicked on to battery power at 85 VAC, for example, it would stay on battery power even as input voltage climbed back up to 90 VAC, 95 VAC, and sometimes even 100 VAC. Hysteresis prevents a UPS from oscillating off and on battery when power hovers near the threshold. The APC SmartUPS 1000 has a sensitivity switch that lets you control the hysteresis (e.g., you can increase hysteresis when voltage is variable).

Some regulation was more complex. When we first tested the line-interactive Upsonic LAN 100, it produced 124-VAC output with 115 VAC going in. After low-voltage testing, it produced 113-VAC output with 115-VAC input. The Upsonic's output at 115 VAC was dependent on how the input had gotten to 115 VAC—whether it had risen, or fallen, to 115 VAC. The Controlled Power LT-1200 is unusual because it uses fuzzy logic to adjust its lower threshold to match load (the lesser the load, the lower the shutdown voltage).

For some UPSes, we tracked output voltage for 5 minutes after going on battery. While on-line units held their output constant, some line-interactive UPSes let output voltage drop over time. Some of the "smarter" line-interactive UPSes—the Superior Electric Stabiline SL 1000, for example—used its transformer to boost the battery and keep the voltage up.

Several of the on-line UPSes regulate overvoltages but don't cut to battery as voltage climbs beyond their specified operating range. This is the case with units from IntelliPower, Toshiba, and Tripp Lite, though the first two have that capability as an option. When we pushed one unit up to 160 VAC, it burned out. You're not likely to run into utility power over 140 VAC, but it does occur in some areas of the world and in miswired buildings.

We tested battery run-down (i.e., hold-up) time under a load that was 70 percent of rated UPS capacity. (Most UPSes were not very accurate in their own load-measuring capabilities, erring conservatively on the high side.) With half load, you should get more than twice as much run-down time as we did.

Although run-down time is related to actual battery capacity, it's a pretty loose relationship. Some UPSes shut down while reporting 70 percent charge remaining. Not only does the UPS prevent you from discharging batteries to destructive levels, in some cases, there's enough charge to go through several consecutive blackouts without battery charging in between. In other words, if programmed differently, some of these units could give you more hold-up time, but at the expense of a safety margin.

In general, all you need is enough time to comfortably shut down whatever server OS you're using. Usually, 5 minutes is okay, but 10 is better. The Controlled Power unit provided an exceptionally long battery life, but it's also a big guy (108 lbs.), as are other on-line units that use a ferroresonant transformer (e.g., the Alpha CFR 1000 and the Best Ferrups).

The Soft Side

The software that makes a UPS suitable for a network server comes in three basic levels of functionality: unattended shutdown, status monitoring, and SNMP monitoring. We judged software functionality at all three levels, giving weight to ease of use (see "Software Rating" in the comparison table). You may not care about some of the more sophisticated UPS software features because you're close enough to eyeball the UPS setup, or because you know you don't have time to learn and configure the software. However, for large networks, the ability to remotely monitor power problems is a labor- and money-saving feature. Also, the best software isn't expensive and often comes with the most cost-competitive hardware.

Most UPS vendors can supply software for most OSes, usually as an option (American Power Conversion includes the software in the UPS price). We tested each UPS's server software under NetWare 3.11 and Windows NT 3.51 (x86 flavor).

Many UPS units come with third-party software, such as System Enhancements' PowerMon II or CompuSci's PowerEdge (often disguised with customized screens). These aren't as good as the best stuff we saw during our testing, although Liebert's UPStation comes with System Enhancements' SiteNet II, an excellent package. Windows NT comes with a built-in UPS program that shuts down a server and logs power outages. Some vendors therefore supply just a communications cable as their NT option. Used with the Windows-based monitoring software some vendors offer, it makes a fairly complete package. Current Windows UPS software can't shut down an NT server, but the Windows 95–compliant programs that can should be available by now.

For this review, all units needed a communications-cable connection and software for shutdown of one or more servers. Desirable software features here are the ability to send alarms to all network workstations (natural to NetWare) and close down all the servers connected to the UPS. Under NT, the latter requires add-on multiplexing hardware so that each server gets a communications cable. Some units offer remote turn-on hardware options that let you control startup or shutdown over phone lines. Pager notification, as found in Tripp Lite's Power Alert Plus, can also be a very useful feature; if power goes out over the weekend, for example, the UPS software will beep your facilities manager.

From the front panel of most UPSes, you can configure the unit, do diagnostics, and check for a weak battery (which requires briefly using battery power). A battery that can't hold much charge doesn't help in an outage.

We rated a UPS and its software on how much diagnostic data the UPS could communicate to the software, and how accessible the software made the data to the systems administrator. Thus, the UPS should have true RS-232 serial communications (rather than just a contact closure connection that signals the power's out and the battery's low). The software should also let you initiate or schedule UPS battery tests. Hewlett-Packard's PowerWise 1000 VA UPS constantly monitors battery health, and Deltec's PowerRite Pro automatically tests its battery every 30 days.

Ideally, you should be able to access your UPS across the network, either with the unit's network software or with optional SNMP hardware and software. Most vendors offer hardware options (internal or external) that provide a direct UPS/network connection, as well as software that makes the UPS management information base (MIB) available to your SNMP platform software. (We tested with HP's OpenVue). There is basically a standard MIB, but many UPSes come with extended MIBs. Agent software makes the data available to the MIB browser of different SNMP platforms. American Power Conversion and Tripp Lite also sell SNMP manager software that provides organized graphics displays of data from multiple UPSes, much like their LAN software.

Other Factors

A clean, well-regulated output signal is a manifestation of quality, and good software makes management easier, but they're not the only factors to consider. Check out service and warranty policies, too. For example, we think the Toshiba 1400S is one of the best on-line UPSes, but it's expensive. However, the company offers a three-year onsite warranty with a 4-hour response time. That may be worth the price to some people.

Weighing price, software, and performance, we highly recommend seven models: five on-line and two line-interactive units. Among on-line models, HP's PowerWise 1000 VA had the best software and a low price; Powercom's ONH-1000 and ONL-1250 both provide good output quality at a low price, as does Exide's Powerware Prestige 1000P-1; and Controlled Power's LT-1200 has the longest battery holdup time, and fuzzy logic, too. For line-interactive UPSes, we recommend APC's Smart-UPS 1000 and Deltec's PowerRite Pro 1000VA, both for great software and clean output.

We give honorable mentions to Tripp Lite's on-line Unison MPS 1200—by the time you read this, it will come with the excellent Power Alert Plus software; Toshiba's on-line 1400S Series 1000VA for its great quality and warranty; Superior Electric's line-interactive Stabiline 1000 for its clean signal and low transfer time; Best's line-interactive Fortress LI 1020B for the same reasons; and Square D-EPE's on-line Topaz SX 900 for the cleanest output. ■

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TECHNOLOGY FOCUS

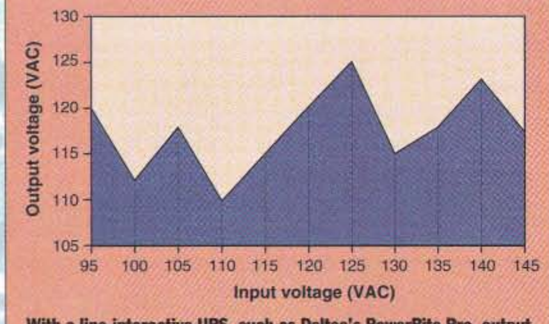
Boost and Buck

Output from a line-interactive UPS varies with the input voltage, but regulation extends the voltage range of input power the UPS can use without going to battery. Typically, the regulator is a transformer with multiple taps that can be switched in or out, depending on line conditions. Like changing gears, the tap switching boosts voltage up when it gets low (brown-out protection) or trims it down when it gets high.

If you plot input against output voltage, you get a sawtooth pattern, as represented by our test results with Deltec's PowerRite Pro 1000VA (see the figure). Lowering input voltage from 115 VAC (to the left), output voltage declines. At 110 VAC on input, the UPS switches to another transformer tap, and output jumps to 118 VAC. (The "less than abrupt" output change that takes place during a tap switch isn't evident here because we took readings at 5-V intervals.) The sawtooth just below 100 VAC is where the unit switched to battery.

Proceeding up from 115 VAC, the output voltage climbs until about 125 VAC, where a tap switch bucks it down to about 115 VAC. Again, as the input voltage continues rising, output rises until just around 140 VAC, when the battery kicks in and output drops to 117 VAC. Some units provide just a single tap point for low voltage. Others provide more than two—as does Tripp Lite's Smart 1050—to provide finer regulation and another tooth in the plot. —Rick Grehan

The Line-Interactive Sawtooth Curve



With a line-interactive UPS, such as Deltec's PowerRite Pro, output voltage varies with input voltage. Regulation by the UPS's transformer keeps output within a tolerable range, but not at a constant level.

Beauty Isn't Only Skin Deep. Neither Is Quality.

The quality of the Toshiba 1400 Plus Series UPS extends much deeper than the surface. Inside you will discover the beauty of our technology, including IGBT high-powered transistors, surface-mount technology circuit boards and a high speed microprocessor in a totally modular design. However, the real beauty lies in the performance of these units. Toshiba's 1400 Plus Series UPS offers a wide input voltage/frequency window and an intelligent charger for increased battery life, high crest factor and overload capabilities, ensuring the UPS will run at its rated value without oversizing. Input power factor correction eliminates overheating of circuits and an RS232 communication feature provides SNMP compatibility and "smart" UPS power monitoring.

Indeed, the beauty of the Toshiba 1400 Plus Series UPS is more than just skin deep. Every unit is built with superior quality and commitment in our ISO 9001 certified U.S. manufacturing facility. Each and every unit (not just random sampling) is inspected and electrically tested to meet stringent quality control standards before it is packaged and shipped to you. We take our protection one step further with Toshiba's "Security Plus" On-Site Warranty, ensuring trouble-free operation and peace of mind for three full years-parts, labor, travel and batteries included. A staff of experienced service technicians is available 24 hours a day-7 days a week for any assistance you may need. No other company can match this protection package offered by Toshiba.

Superior quality, unmatched reliability and true on-line protection are all in one enclosure. This is the true beauty of Toshiba's 1400 Plus Series UPS.

In Touch with Tomorrow
TOSHIBA

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Circle 122 on Inquiry Card (RESELLERS: 123).

Virtual Whiteboards

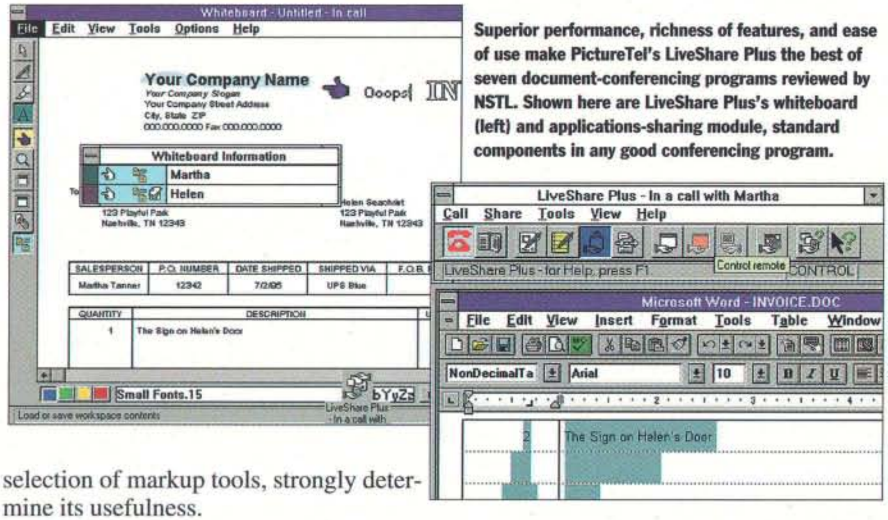
We look at seven desktop-conferencing programs that bring coworkers together over shared, editable documents

DAVID SEACHRIST

Sharing and discussing ideas with colleagues, regardless of their location, is what makes videoconferencing so attractive. But for some collaborative work, you don't have to see and hear each other. Document-conferencing software—a set of tools for sharing "live" documents across remote or networked computers—is often an easier and more cost-effective alternative.

NSTL evaluates seven Windows-based, NetWare-compatible programs that provide some level of collaborative editing of bit-mapped images (a technique known as whiteboarding). All seven also offer varying degrees of file transfer. Most of them let you share and annotate Windows applications. Recognizing the appeal of videoconferencing to many companies, we limited our review to document-conferencing programs that have upgrade paths to videoconferencing.

PictureTel's LiveShare Plus is the clear winner for its ease of use, feature versatility, and performance. Our second and third choices, Intel's ProShare Premier Edition and Future Labs' TalkShow, top LiveShare Plus in supporting conferencing between more than two workstations.


Whiteboard - Untitled - In call
File Edit View Tools Options Help
Ooops!
Whiteboard Information
Martha
Helen
Small Fonts.15
Load or save workspace contents
LiveShare Plus - In a call with
LiveShare Plus - In a call with Martha
Call Share Tools View Help
Control remote
LiveShare Plus - for Help, press F1
CONTROL
Microsoft Word - INVOICE.DOC
File Edit View Insert Format Tools Table Window
NonDecimalTa
Arial
10

Your Company Name
Your Company Slogan
Your Company Street Address
City, State ZIP
000.000.0000 Fax 000.000.0000

123 Playful Park
Nashville, TN 12343

Helen Seachrist
123 Playful Park
Nashville, TN 12343

SALESPERSON	P.O. NUMBER	DATE SHIPPED	SHIPPED VIA
Martha Tanner	12342	7/2/95	UPS Blue

QUANTITY	DESCRIPTION
1	The Sign on Helen's Door

The Sign on Helen's Door

Superior performance, richness of features, and ease of use make PictureTel's LiveShare Plus the best of seven document-conferencing programs reviewed by NSTL. Shown here are LiveShare Plus's whiteboard (left) and applications-sharing module, standard components in any good conferencing program.

Conferencing Basics

Document-conferencing programs offer four main ways to collaborate: whiteboarding, applications and data sharing, file transfer, and real-time text messaging (i.e., chatting). Whiteboard modules are named after their real-world counterparts, but in practice they more resemble paint programs. Because the whiteboard is a graphical environment, documents imported into it can't be edited as they could in a word processor. Instead, editing marks are superimposed on the "page." Thus, a program's ability to get graphics into and out of the whiteboard module, and its selection of markup tools, strongly determine its usefulness.

To get images into whiteboards, the most convenient way is print capture, in which you convert word processing files to print files using a special Windows driver. You can also use import filters to pull in files saved in Windows' BMP format. (All but one of the programs do some type of importing, but they vary widely in the number of file types supported.) A third approach uses the Windows Clipboard to import screens captured from other Windows programs.

Three image-manipulation tools are important in making whiteboarding a comfortable medium. Magnification allows closer scrutiny of the screen. Synchronization refreshes all participants' screens to make sure they are working with the same information at the same time. Page sorters allow browsing and moving document pages by viewing thumbnails. The features comparison table on page 234 shows which products have these tools. (All seven support synchronization.)

Applications-sharing capabilities vary, with some programs offering a remote-control environment that lets users edit files simultaneously. Others periodically send bit-mapped images that can be edited by only one attendee, though seen by all. The reviewed programs do not support this feature as well as they do whiteboarding. In judging them, look for full remote control (where two people can take turns editing the same file) and the ability to share data in the Windows Clipboard.

continued

OVERVIEW

NSTL RATING		VERSION	PERFORMANCE	VERSATILITY	EASE OF LEARNING	EASE OF USE	PRICE
★★★★	LiveShare Plus	2.0	▲	▲	▲	▲	$249
★★★	ProShare Premier Edition	1.6	▼	■	▲	▲	$299
★★★	TalkShow	3.02	■	■	▲	▲	$249
★★★	AT&T Vistium Share	1.0	■	▼	▲	▲	$99
★★	InVision	3.1.23	■	■	▲	■	$595
★★	Person to Person	1.0.3	▼	■	▲	▲	$280
★	Face to Face	2.0.1	▼	▼	▲	■	$59

KEY

★★★★★	Outstanding
★★★★	Excellent
★★★	Average
★★	Below average
★	Poor
▲	Good
■	Fair
▼	Unacceptable

CONFERENCING FEATURES

	AT&T VISTIUM SHARE	FACE TO FACE	INVISION	LIVESHARE PLUS	PERSON TO PERSON	PROSHARE PREMIER	TALKSHOW
Videoconferencing							
Capture video to movie file	○	○	○	○	○	○	●[1]
Capture still to Clipboard	●[1]	○	●	●[1]	●[1]	●[1]	●[1]
Capture still to file	●[1]	○	●	●[1]	●[1]	●[1]	●[1]
Freeze frame	●[1]	○	●	●[1]	●[1]	●[1]	●[1]
Adjust color	●[1]	○	●	○	●[1]	●[1]	●[1]
Whiteboarding							
Selection or screen-capture tool	●	○	●	●	●	●	●
Copy/cut/paste and clear	●	○	●	●	●	●	●
Page sorter/organizer	○	○	●	●	○	●	●
Highlighter tool	●	○	●	●	○	●	●
Magnification (zoom) tool	○	○	●	●	○	●	●
Import graphics files	●	○	●	●	●	●	●
Import text files	●	○	●	○	●	●	●
Import spreadsheet files	○	○	●	○	○	●	●
Import via Windows Clipboard	●	○	○	●	●	●	●
Export graphics files	●	○	●	●	●	●	●
Applications and data sharing							
Share Windows Clipboard	●	○	○	●	●	●	○
Number of applications-sharing participants	2	0	0	2	0	2	Unlimited
Users can request/relinquish control of shared applications	●	○	○	●	○	●	○
Share DOS applications	○	○	○	●	●	●	●
Share Windows applications	●	○	○	●	●	●	●
OLE and DDE support	●	○	●	○	DDE only	●	●
File transfer							
Attach file to message	○	○	○	○	●	○	○
View transfer status	●	○	○	●	●	●	○
Option to compress/decompress files during send/receive	○	○	●	○	●	●	●
Chat							
Number of chat participants	2	0	2	2	8	0	Unlimited
Chat window lists participants	○	○	●	●	●	○	●

[1] Requires additional package sold by same vendor or third-party vendors.

●=yes; ○=no. Features not integral to the package are marked ○ but are sometimes available as options or in future versions.

Conferencing with the World

Will today's document-conferencing products stand the test of time? Unless one of these systems becomes dominant enough to establish a de facto standard, industry standards committees will be needed to fill the void.

T.120 is the standard proposed by the International Telecommunications Union (ITU) to facilitate interoperability of different vendors' document-conferencing products. It's an evolving specification offering guidelines on key aspects of document-conferencing technology, including domains in which conferences can occur, document-conferencing protocols, conference management protocols, and network interfaces. T.120 primarily addresses whiteboarding and file transfer considerations. Applications sharing is not currently a part of the specification.

Though none of the programs in this evaluation comply with T.120, many of the vendors plan to support it in the near future. AT&T plans to add T.120 to Vistium Share eventually. Intel (ProShare Premier Edition) and Future Labs (TalkShow) plan to do so by early next year.

File transfer lets you send files (e.g., a spreadsheet) between conference attendees to allow the sharing of data for off-line and on-line editing. All seven programs do this. Their interfaces vary somewhat, but they all center on the Windows File Open dialog box, where you select files from a scrolling file list and issue a command to send.

Chatting allows the exchanging of text messages in real time. If you're used to the amenities of on-line services such as Prodigy and America Online, you will not be impressed with the relatively simple tools available in these programs.

AT&T Vistium Share

Based on AT&T's TeleMedia Personal Video System, AT&T Vistium Share is a

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low-cost, easy-to-use solution that sacrifices versatility to gain simplicity, though its performance is generally among the best. It lags behind the other programs in its whiteboard and applications- and data-sharing features. (It can't import spreadsheets, for example, and it lacks a page sorter.) Chat support is minimal, and password protection is nonexistent.

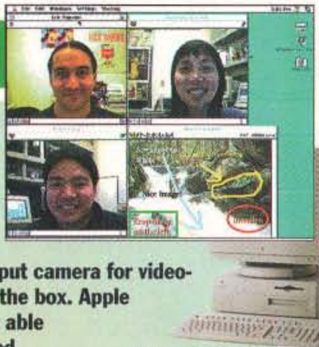
Vistium Share is speedy in five of the six performance tests, slowing down only in network file transfer tests. It's also the only program to support the telephony API (TAPI), making it easier to customize with other telephony applications.

GATHER 'ROUND THE POWER MAC

At MacWorld Expo in August, Apple unveiled what it claims are the first personal computers with built-in conferencing features. Apple Media Conference, a QuickTime conferencing application, will be bundled with the new Power Mac 7500 and 8500.

Though the software works with the PlainTalk microphone supplied with the computer, you must add an NTSC analog-output camera for videoconferencing. Plain document conferencing works right out of the box. Apple claims the product has whiteboarding features, but we weren't able to see how the quality compares with that of the Windows-based products we tested.

The new Power Macs start at $1699. Apple says it will offer an upgrade kit for current Power Mac owners in the first quarter of 1996.



Two new Power Macs make desktop conferencing standard equipment.

Face to Face

Priced at only $59, Crosswise's Face to Face is meant to be a simpler, less-feature-rich solution than the other products. Thus, it lacks applications- and data-sharing features, and it has mediocre speed and versatility.

Face to Face can't import Windows BMP files, which is an important requirement for routine whiteboard use. Instead, you must use the program's print-capture utility to bring documents into the whiteboard.

Face to Face is the only cross-platform product, however, with Macintosh and Windows versions.

InVision

InVision, from InVision Systems, is the only reviewed program that has bundled videoconferencing software. It employs an older—and less feature-rich—version of a competitor, Future Labs' TalkShow, for many of its conferencing features. It is unique, however, in employing OLE,

GENERAL PROGRAM FEATURES

	AT&T VISTIUM SHARE	FACE TO FACE	INVISION	LIVESHARE PLUS	PERSON TO PERSON	PROSHARE PREMIER	TALKSHOW
Communications/Networking							
Number of attendees per document conference (LAN)	2	2	[1]	2	8	2	17 (TCP)
Number of attendees per document conference (modem)	2	2	17 (TCP)	2	8	2	17 (TCP)
Number of video-capture boards supported	2	0	11	0	1	1	0
Document conferencing via plain old telephone system (POTS)	●	●	●	●	●	●	●
Document conferencing via ISDN	○	●	●	○	●	●	●
Document conferencing via LAN	●	●	●	●	●	●	●
Document conferencing via TCP/IP	○	●	●	○	●	●	●
Simultaneous LAN and modem connections in document conference	○	○	●	○	●	○	●
Videoconferencing via POTS[2]	○	○	●	○	○	○	●
Videoconferencing via ISDN[2]	●	○	●	●	○	●	●
Videoconferencing via LAN[2]	○	○	●	●	●	●	●
Videoconferencing via TCP/IP[2]	○	○	●	○	○	●	●
Simultaneous LAN and modem connections in videoconference[2]	○	○	○	○	○	●	○
Supports telephony API (TAPI)	●	○	○	○	○	○	○
Address Book							
Allows multiple-address databases	●	○	●	●	●	●	●
Maintains LAN and modem addresses	●	●	●	●	●	●	●
Attach graphics files (photos) to address	●	○	●	○	○	●	●
Attach movie files to address	○	○	○	○	○	○	○
Miscellaneous							
Number of modem setups included	190	193	43	160	20	183	234
Add custom modem setup	●	●	●	●	●	●	●
Supports Voice over Data (VOD) modems	○	●	●	●	●	●	●
Utility to print third-party files to document image files	●	●	○	●	○	●	●

[1] 13 using IPX/SPX, seven using NetBIOS. [2] Requires additional videoconferencing hardware. ●=yes; ○=no

Features not integral to the package are marked ○ but are sometimes available as options or in future versions.

rather than standard remote control, for applications sharing. This approach makes it harder to use, however.

Along with TalkShow and IBM Direct's Person to Person, InVision allows more than two people to mark up a document per conference. It is among the top two in network file transfer speed, but it's a bit below average in whiteboard speed.

LiveShare Plus

PictureTel's LiveShare Plus clearly offers the best balance of usability, features, and performance. This program is the hands-down winner in two-site conferencing, but it also has numerous other advantages, including the best chat environment and friendly installation.

LiveShare Plus's tool set and work environment are more complete than those of the other programs. Its overall performance score puts it head and shoulders above the rest due to fast file transfer and efficient whiteboard transfers. However, it can't do data sharing over ISDN or TCP/IP lines, and its interoperability support is poor (though the others aren't much better at supporting international standards and non-Windows environments such as the Mac or OS/2).

Person to Person

IBM Direct's offering has the best file transfer features of the group. Besides letting you view the status of incoming and outgoing files and saving the results to a log file, the program allows the attaching of files to text messages, as in E-mail. Its chat windows, like those in LiveShare Plus, are the best of the lot, showing participants' names and date/time stamps of when messages were sent.

Performance is Person to Person's downfall. Surprisingly, its two-level compression scheme somehow results in *more* bytes flying across the network during file transfers.

Person to Person's whiteboard lacks a highlighter tool, a page sorter, and a zoom option—all helpful during the often awkward process of coordinating shared document editing.

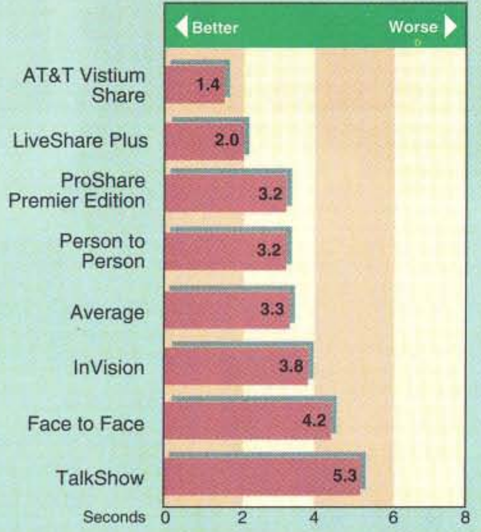
ProShare Premier Edition

Intel's document-conferencing program offers usability and features comparable to LiveShare Plus. It is our second choice, winning high praise for ease of use. It has excellent applications-sharing and file transfer features, and an especially user-friendly whiteboard.

As is the case with Face to Face, InVision, and TalkShow, ProShare Premier Edition comes with a receive-only version that you can send to conference participants. This purposely limited version of the program does not let recipients initiate their own conferences.

But for disappointing performance, ProShare Premier Edition might have been our top pick. However, the product also is hurt by lack of a whiteboard eraser, chat module, and password protection.

Graphing Whiteboards



AT&T Vistium Share was the fastest program at updating a graph displayed on the whiteboard. This test used uncompressed files to measure network performance only (factoring out file loading, format conversion, establishing the network link, and so forth).

TalkShow

TalkShow's multipoint conferencing and strong support of transfer protocols merit praise. The program lets LAN and modem participants join a single conference (InVision and Person to Person also do it), and it's the only one that lets you scan documents directly into the whiteboard.

Ranking near the top in ease of use, TalkShow is only middling in performance and feature versatility. Raw file transfer speed is among the fastest, but network efficiency in whiteboard transfers (which adds file size to the equation) is among the worst. The program's applications-sharing module lets only one participant make changes, and its chat windows are not as informative as those in Person to Person and LiveShare Plus. However, its whiteboard is among the easiest to use. It employs a slide-tray metaphor that functions as a page sorter. ■

Product Information

AT&T Vistium Share 1.0.......$99
AT&T Global Information Solutions
Dayton, OH
(800) 447-1124
Circle 1232 on Inquiry Card.

Face to Face 2.0.1.................$59
Crosswise Corp.
Santa Cruz, CA
(800) 747-9060
(408) 459-9060
fax: (408) 426-3859
Circle 1233 on Inquiry Card.

InVision 3.1.23............$595
InVision Systems Corp.
Tulsa, OK
(800) 847-1662
fax: (918) 584-7775
Circle 1234 on Inquiry Card.

LiveShare Plus 2.0.............$249
PictureTel Corp.
Danvers, MA
(800) 716-6000
(508) 762-5000
fax: (508) 762-5245
Circle 1235 on Inquiry Card.

Person to Person 1.0.3............$280
IBM Direct
(800) 342-6672
fax: (512) 823-1864
Circle 1236 on Inquiry Card.

ProShare Premier Edition 1.6..........$299
Intel Corp.
Hillsboro, OR
(800) 538-3373
(503) 629-7354
fax: (503) 264-6223
Circle 1237 on Inquiry Card.

TalkShow 3.02.............$249
Future Labs, Inc.
Los Altos, CA
(415) 254-9000
fax: (415) 254-9010
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HANDS-ON TESTING

12 NETWORK PRINTERS

Keep those print jobs rolling with these fast, 16- to 32-page-per-minute networked laser printers and stay ahead of the paper flow

JIM KANE

Maybe your 12-page-per-minute networked laser printer just doesn't cut it anymore, with print jobs festering in the print queue because of its too-slow print engine. Perhaps you need some duplexing capabilities, or maybe you just want to be able to know if the printer is off-line, out of paper, or tied up. Your old printer was OK when you just had a handful of employees sending print jobs, but now your company has grown, and you need a faster, networkable, more manageable unit.

We evaluated 12 network laser printers with print speeds ranging from 16 to 32 ppm—fast enough to satisfy the needs of larger workgroups. These faster devices also have built-in Ethernet capabilities, so you don't have to use a PC as a baby-sitter to provide network functionality.

With third-party equipment, any printer can be considered a network printer, so we focused on network integration and tested only those printers with internal network interfaces (either standard or optional). Network management software helps differentiate between dedicated network printers and those with third-party add-ons. Network-printer-management software delivers configuration tools to the workstation and also reports the remote printer's status to your PC, keeping you informed.

To get real-world network performance numbers, we tested only monochrome printers in network configurations. Most of these units—which range in price from $3549 for the desktop Hewlett-Packard LaserJet 4MV to $29,616 for the copy-machine-size Dataproducts Typhoon 30—have at least two paper-input trays that are switchable on demand via the driver or the printer management software.

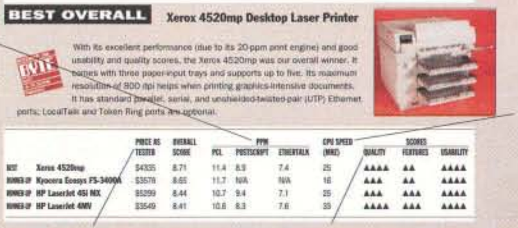
These 300- to 1200-dot-per-inch-resolution printers allow documents with typical graphics to print relatively fast, along with the normal flow of letters and other text documents. The 1200-dpi devices, however, slow down when you send print jobs that have complex graphics.

We categorized these network printers into two groups: 16- to 20-ppm units and 30- to 32-ppm units. The 16- to 20-ppm printers are more common in smaller offices than their high-speed counterparts and offer higher-quality output. You can buy three or four of the 16- to 20-ppm printers for the cost of the least expensive 30- to 32-ppm printer that we put through the paces. Only two of the devices in the lower-speed group exceed $5000 as configured for testing.

How to use this guide

We used our suite of PC- and Macintosh-based printer tests to choose the fastest network printers with the best-quality output. We summarize test details about the winners and runners-up in each of the two categories (16- to 20-ppm and 30- to 32-ppm printers) using charts like the one shown here.

The vendor's rating for engine or print-head speed, measured in pages per minute; it does not include printer-processing time.



BEST OVERALL **Xerox 4520mp Desktop Laser Printer**

With its excellent performance (due to its 20-ppm print engine) and good usability and quality scores, the Xerox 4520mp was our overall winner. It comes with three paper-input trays and supports up to five. Its maximum resolution of 800 dpi helps when printing graphics-intensive documents. It has standard parallel, serial, and unshielded-twisted-pair (UTP) Ethernet ports; LocalTalk and Token Ring ports are optional.

		PRICE AS TESTED	OVERALL SCORE	PPM			CPU SPEED (MHZ)	SCORES		
				PCL	POSTSCRIPT	ETHERTALK		QUALITY	FEATURES	USABILITY
BEST	Xerox 4520mp	$4335	8.71	11.4	8.9	7.4	25	▲▲▲▲	▲▲	▲▲▲▲
RUNNER-UP	Kyocera Ecosys FS-3400A	$3578	8.65	11.7	N/A	N/A	16	▲▲▲	▲▲	▲▲▲▲
RUNNER-UP	HP LaserJet 4Si MX	$5299	8.44	10.7	9.4	7.1	25	▲▲▲	▲▲▲	▲▲▲▲
RUNNER-UP	HP LaserJet 4MV	$3549	8.41	10.6	8.3	7.6	33	▲▲▲▲	▲▲▲	▲▲▲▲

The printer's processor speed, measured in MHz.

The price of the as-tested configuration, which may include optional memory (see the Roll Call on page 246).

A composite rating for text- and graphics-output quality; based on a 10-point scale, with higher numbers indicating better print quality.

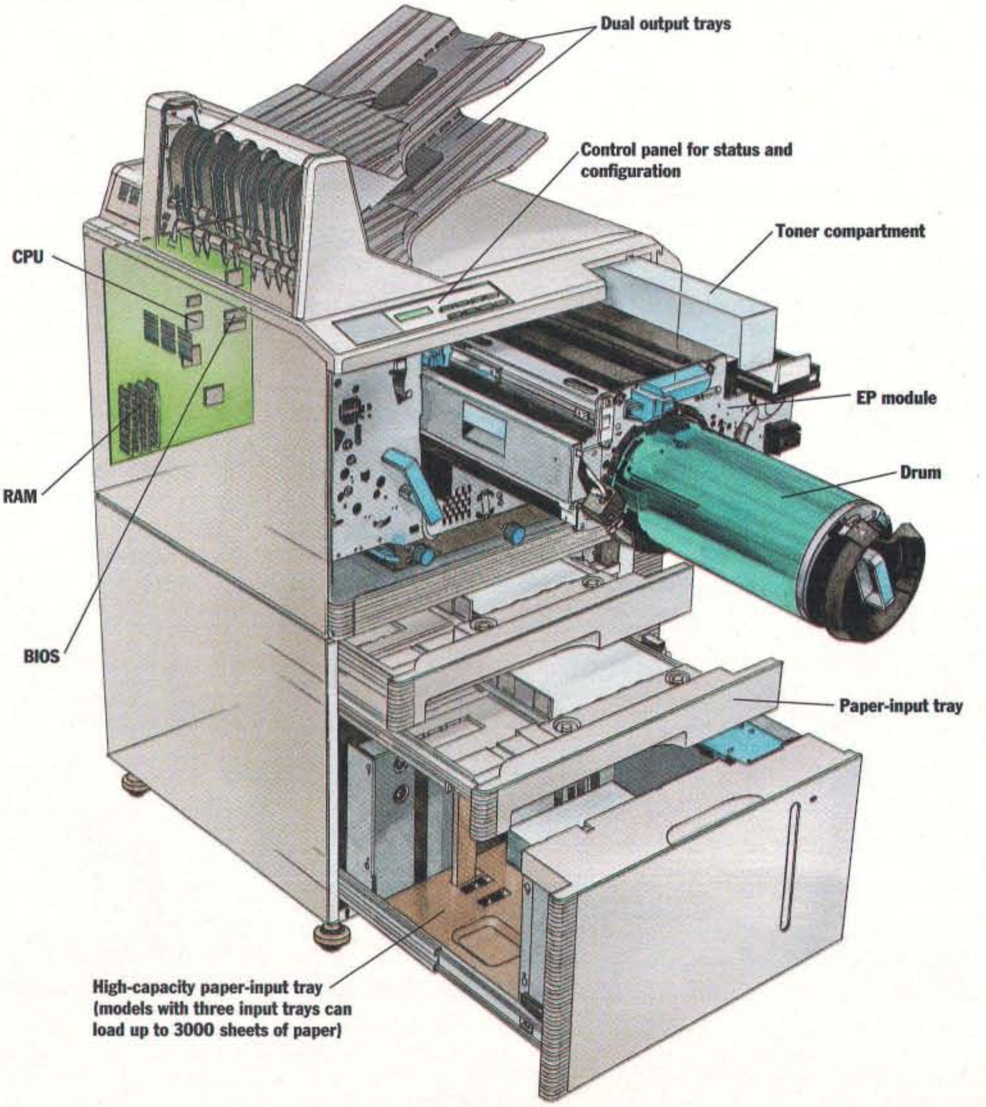
The major differences between desktop lasers (some of which are featured here as printers for smaller networks) and the console-type, high-volume/high-speed lasers is that the high-end units provide larger paper capacities, faster engine speeds, better longevity, and security features.

Of course, there are also price/performance issues to consider when choosing a network printer. Do you really need a 30-ppm printer/fax machine when three

PHOTOGRAPHY: STEVE BELKOWITZ © 1995

SET THE PACE

Built for Speed


Dual output trays
Control panel for status and configuration
Toner compartment
CPU
EP module
Drum
RAM
BIOS
Paper-input tray
High-capacity paper-input tray (models with three input trays can load up to 3000 sheets of paper)

smaller, slower, dedicated print servers distributed evenly throughout the building would solve your printer problems? Or do your users queue up 100-page jobs regularly, making it more cost-effective to wait 4 minutes for a print job to get to the front of the line, and 4 minutes more for it to print, instead of fighting through the local queue only to wait 15 minutes for the print to complete?

You must also take into account the normal duty cycles of these printers. The higher-end, faster printers are supposed to last significantly longer between maintenance and consumables replacement. The median duty cycle for the 30- to 32-ppm printers is 200,000 pages, compared to 50,000 pages for the 16- to 20-ppm units.

NOVEMBER 1995
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16- TO 20-PPM PRINTERS

BEST OVERALL

Xerox 4520mp Desktop Laser Printer

This 20-ppm desktop printer is great for midsize workgroups and is affordably priced at $4335. It offered excellent across-the-board performance in our PostScript, Printer Control Language (PCL), and EtherTalk performance tests. **PAGE 241**

HIGH-QUALITY

Lexmark Optra Lx

For quality output, the 16-ppm Optra Lx ($3997) bests all other printers in this group with its support for resolutions of up to 1200 dpi. But the drawback of this high quality is reduced performance: The Optra performed poorly in our PostScript and PCL performance tests. It supports up to 64 MB of memory, has two external font slots, and supports three paper-input trays. **PAGE 241**

MACINTOSH

Kyocera Ecosys FS-3600A

Number one in both EtherTalk and PostScript performance in this group, the 18-ppm Kyocera Ecosys achieved an overall EtherTalk score of 9.5 ppm, second only to that of the QMS 3225 Print System, which swept the higher-end 30- to 32-ppm category. **PAGE 241**

30- TO 32-PPM PRINTERS

BEST OVERALL

QMS 3225 Print System

With a blazingly fast 19.2-ppm rating in our PCL performance tests, the QMS 3225 Print System is by far the fastest printer that we put through the paces. **PAGE 243**

HIGH-QUALITY

QMS 3225 Print System

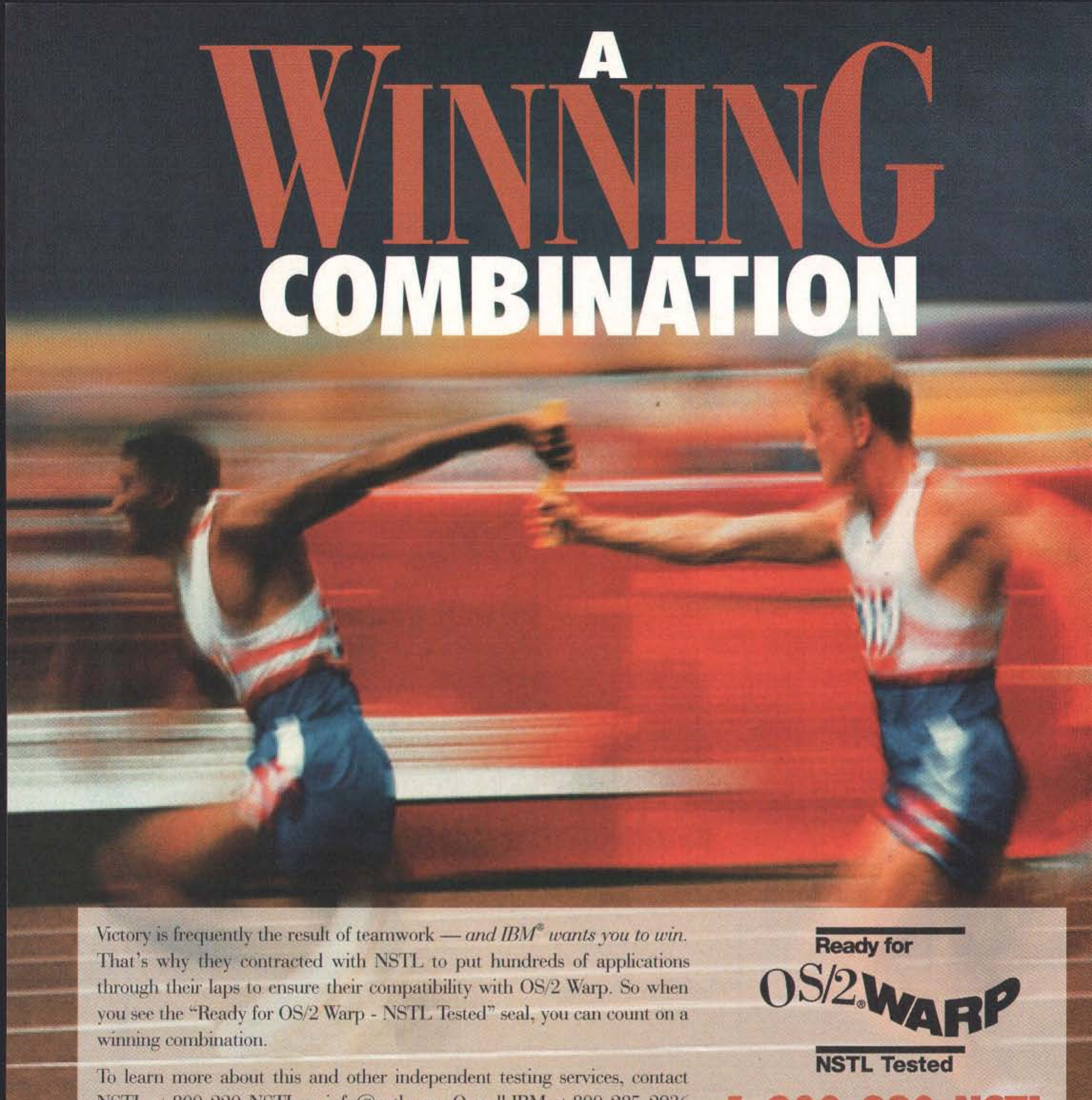
This printer's 400-dpi output breaks through the 300-dpi-resolution barrier. This $17,149 console system has the highest quality-index score of the three printers in this category. **PAGE 243**

MACINTOSH

QMS 3225 Print System

It's a sweep for the 3225 as it takes the Mac category, too. With its support for three paper-input trays and 3000 sheets of paper, it can stave off the needs of many networked users. The unit also has a 200,000-page monthly duty cycle. **PAGE 243**

ILLUSTRATION: BRUCE SANDERS © 1995



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DUX Software's American Heritage Dictionary Concise Edition™
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Grolier Electronic Publishing's 1995 Multimedia Encyclopedia
Intellisoft's™ Accounting Vision/32™
Interplay's™ Mario's® Game Gallery
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Merit Studios' Fortress of Dr. Radicki™
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MicroDoc Products, Inc.'s Child Development Guide
MicroLearn Nordic's Game Pack Volume I
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Parsons Technology's Money Counts®
Pinnacle Technology's Kid Proof/2™
Reed Software's OS/2 Black Jack
Stardock System Inc.'s™ Star Emperor™
Stardock System Inc.'s™ Havoc™
Starpress Multimedia's 808 Great Letters
T/Maker's ClickArt Newsletter Art

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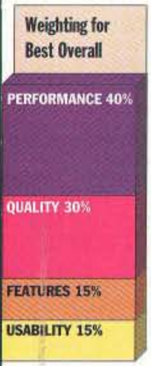
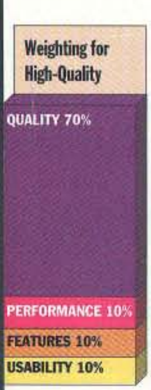
16- TO 20-PPM PRINTERS

For most needs, one of the nine 16- to 20-ppm laser printers that we tested should be fast enough for midsize offices with 25 to 75 users wired to a network. These printers generally can handle enough volume so that you won't have to call crowd control whenever multiple print jobs are sent to the queue. Although the 30- to 32-ppm lasers offer more speed and paper-handling capabilities, the 16- to 20-ppm units have the ability to print higher-quality documents with integrated graphics.



Most of these printers are desktop units that support 600-dpi output and let you print general graphics relatively quickly. Some support resolutions of up to 1200 dpi, which is great for detailed reports; however, you may have to wait a bit if your text report is in the queue behind a coworker's complex newsletter. The average cost of the printers in this category is $4236, and only two exceed $5000 for their as-tested configurations.

Our overall winner in this category is the Xerox 4520mp Desktop Laser Printer, by virtue of its 20-ppm print speed and high quality. Also ranking high is the Kyocera Ecosys FS-3400A; it ripped through our PCL tests with the best score in the group. However, it didn't come with a PostScript option, which eliminated it from our PostScript and EtherTalk tests. The FS-3400A printed at 11.7 ppm in the PCL tests, and if you just need to print in PCL mode, it's a bargain at $3578.



At $3699, the 16-ppm Dataproducts Typhoon 16 is another outstanding lower-priced network printer. The unit's performance scores were below average, but only Lexmark's Optra Lx had a better quality-index rating. In addition, the Typhoon 16 had the best features score in this category, as well as one of the best ease-of-use ratings.

Finally, HP's 600-dpi LaserJet 4MV ($3549) and LaserJet 4Si MX ($5299) put up strong performance numbers in our three subcategories and had above-average quality scores. HP is rumored to be introducing a replacement model for the 4Si, a new 24-ppm laser that will be available sometime in November.

High speed and quality

BEST OVERALL

Xerox 4520mp Desktop Laser Printer

With its excellent performance (due to its 20-ppm print engine) and good usability and quality scores, the Xerox 4520mp was our overall winner. It comes with three paper-input trays and supports up to five. Its maximum resolution of 800 dpi helps when printing graphics-intensive documents. It has standard parallel, serial, and unshielded-twisted-pair (UTP) Ethernet ports; LocalTalk and Token Ring ports are optional.

		PRICE AS TESTED	OVERALL SCORE	PPM			CPU SPEED (MHZ)	SCORES		
				PCL	POSTSCRIPT	ETHERTALK		QUALITY	FEATURES	USABILITY
BEST	**Xerox 4520mp**	$4335	8.71	11.4	8.9	7.4	25	▲▲▲▲	▲▲	▲▲▲▲
RUNNER-UP	**Kyocera Ecosys FS-3400A**	$3578	8.65	11.7	N/A	N/A	16	▲▲▲	▲▲	▲▲▲▲
RUNNER-UP	**HP LaserJet 4Si MX**	$5299	8.44	10.7	9.4	7.1	25	▲▲▲	▲▲▲	▲▲▲▲
RUNNER-UP	**HP LaserJet 4MV**	$3549	8.41	10.6	8.3	7.6	33	▲▲▲▲	▲▲▲	▲▲▲▲

When looking sharp counts...

HIGH-QUALITY

Lexmark Optra Lx

If detailed documents are your main concern, then the 1200-dpi Lexmark Optra Lx deserves a close look. It may not have lightning-fast performance, but it achieved the highest quality scores in this report. With its accompanying MarkVision management and monitoring software, the Optra Lx is one of the easiest-to-use printers we tested. The unit in this group that outscored it in usability was the 1200-dpi QMS 1660E Print System.

		PRICE AS TESTED	OVERALL SCORE	PPM			CPU SPEED (MHZ)	SCORES		
				PCL	POSTSCRIPT	ETHERTALK		QUALITY	FEATURES	USABILITY
BEST	**Lexmark Optra Lx**	$3997	8.34	7.1	5.3	4.9	25	▲▲▲▲	▲▲	▲▲▲▲
RUNNER-UP	**QMS 1660E Print System**	$3999	8.12	9.5	7.5	6.9	33	▲▲▲▲	▲▲▲	▲▲▲▲
RUNNER-UP	**Dataproducts Typhoon 16**	$3699	8.08	6.7	7.0	6.6	25	▲▲▲▲	▲▲▲▲	▲▲▲▲
RUNNER-UP	**HP LaserJet 4MV**	$3549	8.05	10.6	8.3	7.6	33	▲▲▲▲	▲▲▲	▲▲▲▲

A fast paper-pusher

MACINTOSH

Kyocera Ecosys FS-3600A

Our choice for best overall printer for the Mac is the Kyocera Ecosys FS-3600A. With its as-tested price of $4278, this printer supports resolutions of up to 600 dpi. The FS-3600A blew away the other printers in the EtherTalk ppm ratings with a score of 9.5. The nearest competitor in the group was the HP LaserJet 4MV, which sported a 7.6-ppm rating. The Dataproducts Typhoon 16, boosted by quality, features, and usability all superior to that of the top-rated Mac printers, was a close third.

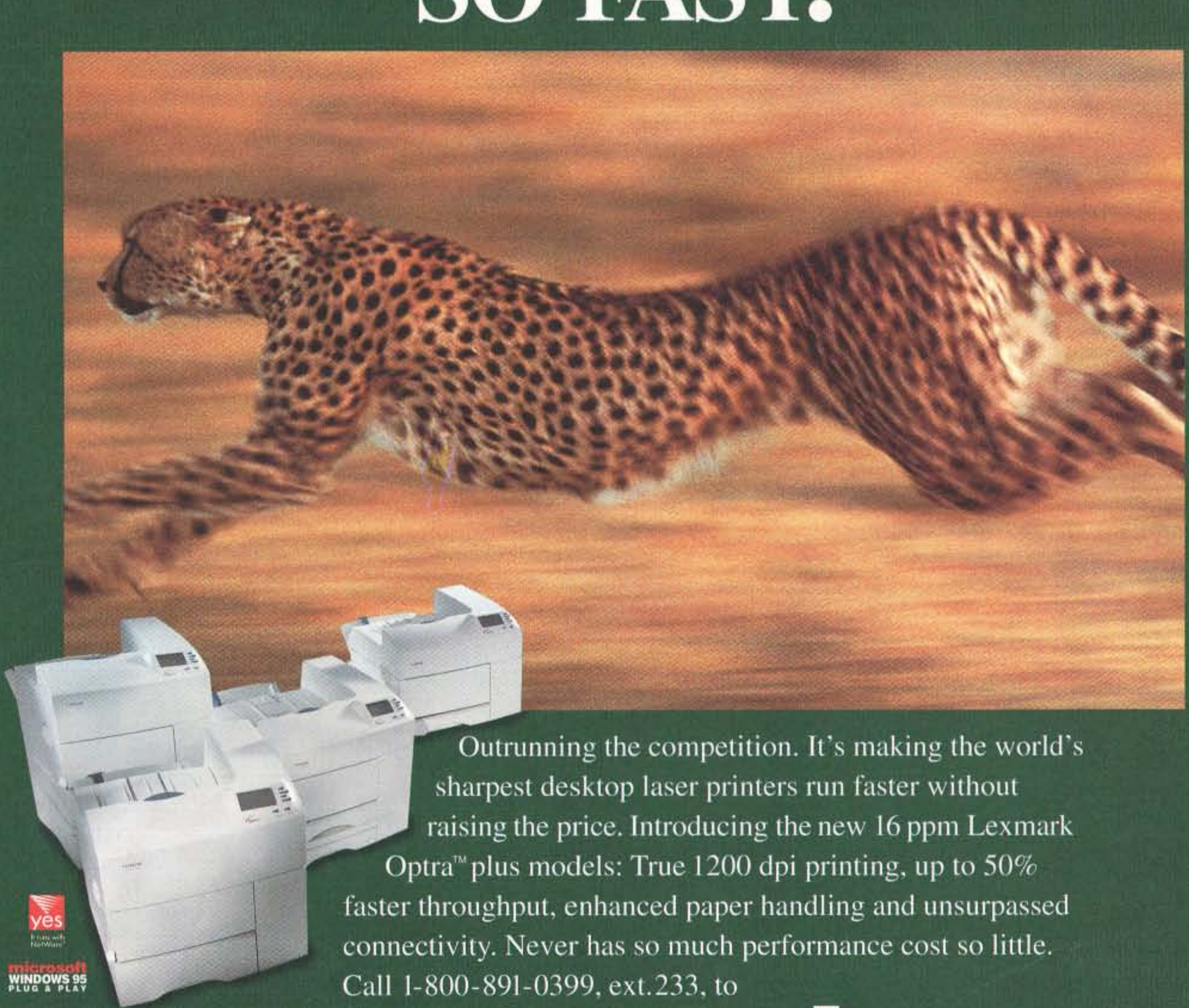
		PRICE AS TESTED	OVERALL SCORE	PPM			CPU SPEED (MHZ)	SCORES		
				PCL	POSTSCRIPT	ETHERTALK		QUALITY	FEATURES	USABILITY
BEST	**Kyocera Ecosys FS-3600A**	$4278	7.4	9.4	10.0	9.5	50	▲▲▲	▲▲	▲▲▲▲
RUNNER-UP	**HP LaserJet 4MV**	$3549	6.9	10.6	8.3	7.6	33	▲▲▲▲	▲▲▲	▲▲▲▲
RUNNER-UP	**Dataproducts Typhoon 16**	$3699	6.8	6.7	7.0	6.6	25	▲▲▲▲	▲▲▲▲	▲▲▲▲
RUNNER-UP	**Xerox 4520mp**	$4335	6.75	11.4	8.9	7.4	25	▲▲▲▲	▲▲	▲▲▲▲

KEY

Ratings from 1 to 4: ▲ is the lowest; ▲▲▲▲ is the highest.

Lexmark introduces new 1200 dpi Optra laser printers.

RARELY HAVE SO MANY DOTS MOVED SO FAST.



Outrunning the competition. It's making the world's sharpest desktop laser printers run faster without raising the price. Introducing the new 16 ppm Lexmark Optra™ plus models: True 1200 dpi printing, up to 50% faster throughput, enhanced paper handling and unsurpassed connectivity. Never has so much performance cost so little. Call 1-800-891-0399, ext.233, to receive a free Optra print sample. Or visit our Web Site at http://www.lexmark.com. And see for yourself just how well we run.

LEXMARK™

ADVANCING THE ART OF PRINTING

1200 dpi printing may require additional printer memory depending on file complexity and Optra model. 16 ppm at 300 and 600 dpi. 8 ppm at 1200 dpi. Microsoft is a registered trademark and Windows a trademark of Microsoft Corp. NetWare is a registered trademark of Novell Inc. Lexmark and Optra are trademarks of Lexmark International, Inc.

BYTE BEST

20- TO 32-PPM PRINTERS

Eat my dust

BEST OVERALL

QMS 3225 Print System

This 32-ppm printer is the only unit to achieve double-digit performance in our PCL, PostScript, and EtherTalk tests (with scores of 19.2, 14.6, and 12.8 ppm, respectively). It offers duplexing capability, two regular input trays, and a high-capacity input tray. The QMS 3225 also has two output trays, a hard drive, and a floppy drive. This printer has good features and usability, but its performance really puts it over the top in this category: It's 7 ppm faster than the first runner-up, the Xerox 4230/MRP.

		PRICE AS TESTED	OVERALL SCORE	PPM			CPU SPEED (MHZ)	SCORES		
				PCL	POSTSCRIPT	ETHERTALK		QUALITY	FEATURES	USABILITY
BEST	QMS 3225 Print System	$17,149	9.0	19.2	14.6	12.8	33	▲▲▲	▲▲▲	▲▲▲▲
RUNNER-UP	Xerox 4230 MRP	$20,245	7.3	12.5	12.9	9.2	20	▲▲▲	▲▲▲	▲▲▲▲
RUNNER-UP	Dataproducts Typhoon 30	$29,616	6.8	11.1	10.5	7.9	33	▲▲▲	▲▲▲	▲▲▲▲

Scale up for quality output

HIGH-QUALITY

QMS 3225 Print System

At 400 dpi, the QMS 3225 has the highest quality scores, which, combined with its excellent performance, make it the best-quality printer of these lower-resolution lasers. Its standard features include auto-sensing between emulations, PostScript Levels 1 and 2, and Hewlett-Packard LaserJet III (PCL 5) emulation. The first runner-up, the Dataproducts Typhoon 30, also supports 400 dpi, and its quality scores are similar to those of the QMS 3225.

		PRICE AS TESTED	OVERALL SCORE	PPM			CPU SPEED (MHZ)	SCORES		
				PCL	POSTSCRIPT	ETHERTALK		QUALITY	FEATURES	USABILITY
BEST	QMS 3225 Print System	$17,149	8.0	19.2	14.6	12.8	33	▲▲▲	▲▲▲	▲▲▲▲
RUNNER-UP	Dataproducts Typhoon 30	$29,616	7.5	11.1	10.5	7.9	33	▲▲▲	▲▲▲	▲▲▲▲
RUNNER-UP	Xerox 4230 MRP	$20,245	7.3	12.5	12.9	9.2	20	▲▲▲	▲▲▲	▲▲▲▲

It's a sweep

MACINTOSH

QMS 3225 Print System

With an EtherTalk rating of 12.8 ppm, the QMS 3225 easily outperformed the other printers in all aspects of Mac printing, except for the font test, for which the Typhoon 30 took top honors. A 9.2-ppm EtherTalk rating, combined with excellent features and usability, made the Xerox 4230/MRP the first runner-up. The Typhoon 30 offered good EtherTalk performance, but it wasn't good enough to beat the other printers in the group.

		PRICE AS TESTED	OVERALL SCORE	PPM			CPU SPEED (MHZ)	SCORES		
				PCL	POSTSCRIPT	ETHERTALK		QUALITY	FEATURES	USABILITY
BEST	QMS 3225 Print System	$17,149	9.0	19.2	14.6	12.8	33	▲▲▲	▲▲▲	▲▲▲▲
RUNNER-UP	Xerox 4230 MRP	$20,245	7.5	12.5	12.9	9.2	20	▲▲▲	▲▲▲	▲▲▲▲
RUNNER-UP	Dataproducts Typhoon 30	$29,616	7.0	11.1	10.5	7.9	33	▲▲▲	▲▲▲	▲▲▲▲

KEY

Ratings from 1 to 4: ▲ is the lowest; ▲▲▲▲ is the highest.

The three high-end network printers we tested—the Dataproducts Typhoon 30, QMS 3225 Print System, and Xerox 4230/MRP—are all built for speed and durability. These workhorses are best suited for offices with high-volume-text and duplex print jobs. They range in price from approximately $17,000 to $30,000 and feature multiple paper-input trays and high-capacity loaders and stackers that help differentiate them from the 16- to 20-page-per-minute lasers.

With resolutions of 300 and 400 dpi, these printers produce output that's not as high-quality as that of the 16- to 20-ppm units, but they can produce acceptable charts, spreadsheets, and simple graphics for use in typical business reports.

Although it's seemingly a stretch to rate printers with resolutions of 300 and 400 dpi for quality, remember that these printers are not designed to spit out presentation graphics, but rather to satisfy the needs of larger workgroups. We rated them on the same quality scale as their 16- to 20-ppm counterparts; as a result, their scores are low.

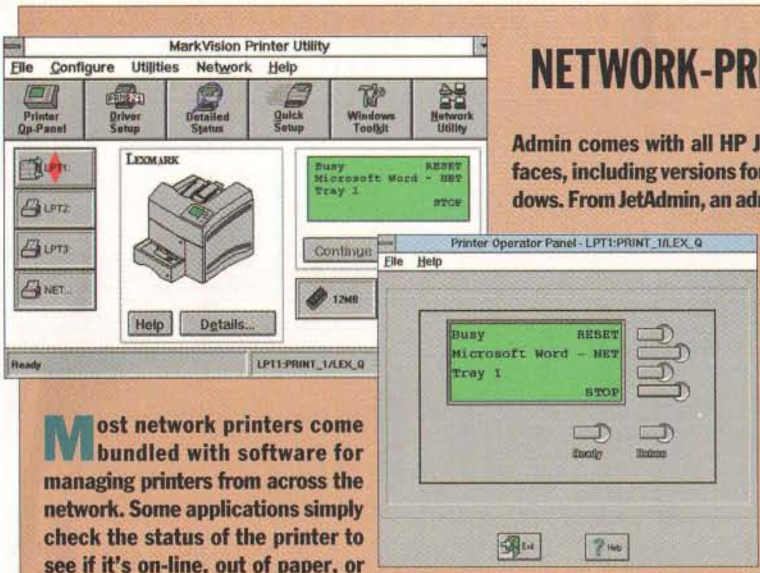
Although the QMS 3225 received top honors in all categories in this group, the other two units in our test-bed also had strong performance scores. The Xerox 4230/MRP comes closest to the QMS 3225 in speed, with an average rating of 11.5 ppm when its PostScript, PCL, and EtherTalk test scores are combined. The QMS 3225 zips through the tests at an average of 15.5 ppm, while the Typhoon 30 averages out at 9.8 ppm.

At $20,245 as tested, Xerox's 4230/MRP is the least expensive of the group. Its accompanying printer management software makes network configuration a breeze. The 4230/MRP has a 230,000-page monthly duty cycle and supports five paper-input trays, for up to 1800 sheets of paper, and a high-capacity output tray.

The 30-ppm Dataproducts Typhoon 30 is the most expensive printer in the group, sporting an as-tested price of $29,616. However, it offers some technological advances that set it apart from the others. A paper-feed mechanism enables you to refill one paper tray while the printer feeds from another tray, allowing continuous operation. The toner compartment can also be filled on the fly. In addition, the Typhoon 30 uses Dataproducts' Virtual Printer Technology (VPT), which adds network smarts to printers by acknowledging and receiving up to 64 different printer configurations concurrently.

The Typhoon 30 supports five paper-input trays and 3500 sheets of paper. The device offers a 200,000-page monthly duty cycle.

NETWORK-PRINTER-MANAGEMENT SOFTWARE



```
Busy                RESET
Microsoft Word - NET
Tray 1
                     STOP
```

Most network printers come bundled with software for managing printers from across the network. Some applications simply check the status of the printer to see if it's on-line, out of paper, or busy. Most include some sort of configuration capability. But some applications go further. Below are some notable features of the software we tested.

PrintWatch. Dataproducts' PrintWatch for Windows can monitor the print server and its status via TCP/IP, as well as configure the printer. Although it's more difficult to configure and install than some other utilities, it's easy to use once you set it up.

JetAdmin and JetPrint. Hewlett-Packard's JetAdmin provides configuration capabilities and printer-status information for users and administrators. Easy to use and install, JetAdmin comes with all HP JetDirect interfaces, including versions for DOS and Windows. From JetAdmin, an administrator has the ability to lock the printer's physical control panel. It also allows you to see what jobs are active on all queues. JetPrint configures both the print server and queue and maintains status information on the printer.

Printset. Kyocera's Printset utility for Windows creates a Novell Print Server and provides TCP/IP and AppleTalk configuration information. Printset also keeps track of the printer's status, but the status information is not as detailed as it is with many of the other utilities.

MarkVision. LexMark's MarkVision for Windows uses bidirectional communications to maintain, configure, and track the printer's status. A graphical representation of the printer's control panel and a detailed printer-status window let you know what's going on. The utility is a little confusing to install, but it's easy to use.

CrownAdmin. QMS's CrownAdmin for Windows and the Mac manages and configures QMS network printers. It searches out the printers by address and allows on-line configuration, but without any TSRs. CrownAdmin does not create your Novell Print Server for you, but it provides the name and printer descriptions in the NetWare configuration-menu item. It's easy to install and use.

Document Services for Printing (DSP) and XRXADMIN. Xerox offers two network-printer-management utilities for DOS. The DSP management/utility software installs easily and sports an easy-to-use interface. It helps you select a "best-fit" printer, depending on your output needs. DSP can track the status of multiple printers on the network as well as install the Novell PSERVER for you. The only downside: two TSRs for the printer-status application and terminal emulation.

XRXADMIN is easy to install and use and doesn't require a TSR. However, it seems to be designed more for printer configuration and management than for keeping tabs on printer status. The Xerox NICPRINT.EXE utility finds the printer for you and creates a PSERVER. However, it didn't run reliably under Windows as a DOS session.

HONORABLE MENTIONS

Masochistic as it may sound, we actually enjoyed clearing paper jams with a couple of these printers. The control panel of the **Xerox 4230/MRP** directs you to the paper jam's specific area and requests that you open the correct doors to clear the jam. The LED of the **Dataproducts Typhoon 30** also gives on-target directions on how to find and clear paper jams. Note that, aside from a small mechanical failure in one printer, we had to cause the jams ourselves; the units showed no desire to jam on their own.

Xerox 4230/MRP

Dataproducts Typhoon 30

Interesting and innovative if nothing else, the **Lexmark Optra Lx's MarkVision** software alerts you of any problems with audio messages. Through the PC's speaker, you can barely hear the message "clear paper jam" when a paper jam occurs or "thank you" when you fix it. However, with better sound capability, it works great. This may be a little annoying to some, but mainly just to those who don't expect sound or who don't have a high-quality sound card.

Dubious Achievement

Although the **QMS 3225 Print System** has many attributes we like, it has one feature that we really can't stand: Page Sensing Tabs for the paper-input trays. These tabs tell the printer what kind of paper you're using. As with the paper-tray *keys* found on other printers, these devices help you use the same paper tray for different-size paper. From experience, we know that small pieces like these can vanish in an instant—down a heating duct or somewhere inside the printer.

How We Tested

To pick the top network laser printers, we test the devices' performance (i.e., speed), quality of printed output, features, and usability. We test and score each of these elements separately, and then we compute the overall score by assigning a weight to each element. For example, we assign weights in the overall performance category as follows: 40 percent for performance, 30 percent for quality, 15 percent for features, and 15 percent for usability. For the high-quality category, the weighting is 10 percent for performance, 70 percent for quality, 10 percent for features, and 10 percent for usability. In the Mac category, we use the same formula that we use for the best overall category. The only difference is that we use the EtherTalk rating for the performance score.

PERFORMANCE

We set each printer to poll the network as frequently as possible to ensure we get the most consistent times attainable. NSTL's performance tests measure how fast a printer can print text, graphics, and fonts. The dense-text test requires printing a 2-KB file of ASCII text with little white space. Performance in this test correlates to raw speed, because there are no fonts or graphics for the printer to interpret.

The graphics tests use bit-mapped images to simulate documents with custom fonts or screen shots. These tests help us determine how efficiently each printer communicates with a computer. One test measures the printer's ability to draw complex lines and filled areas. A second test produces curves and gray scales. An additional complex-graphics test, created in CorelDraw, includes gray-scale shading, lensing, and other complex images. This test stresses the printer's processor and RAM capabilities.

We also use the font test to measure the speed of a printer's processor. This test requires printers to create Times (serif) and Helvetica (sans serif) fonts in regular and boldface in 30 different point sizes. We immediately repeat this test without resetting the printer to determine the unit's font-caching capabilities.

PRINT QUALITY

NSTL's print-quality tests measure a unit's ability to produce a photographic image; print attractive, legible text in a wide range of sizes; and draw lines. Because most laser printers produce monochrome-only output, color-print-quality tests are not included in this review. The line-squeeze test forces a printer to draw two lines increasingly closer together until the gap between them vanishes, which indicates the printer can no longer make the black-to-white-to-black transition. The test suite also gauges other print-quality considerations, such as how accurately the unit positions paper and how well it displays reversed (i.e., white-on-black) text and graphics.

OTHER FACTORS

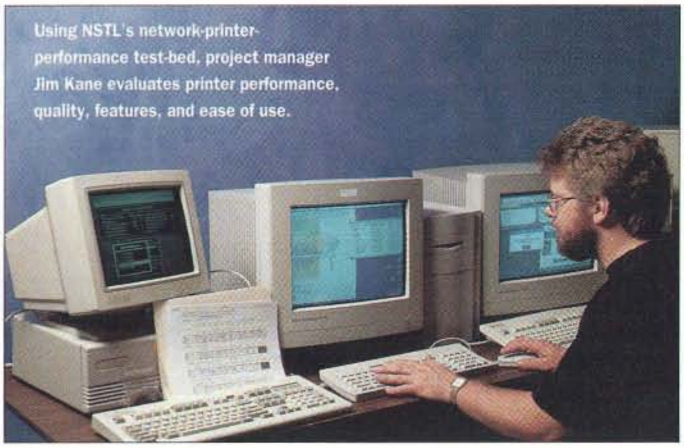
Participating vendors supplied us with responses to a printer-features survey that included a wide range of questions about what emulations are supported, the printers' maximum horizontal and vertical resolutions, and what services are included with the standard warranty. We verified these responses and assigned a features score based on the most important features. We also evaluated how easy the printers are to use, based on such aspects as ease of ink-medium installation, intuitiveness of the control panel, ease of driver installation, ease of network setup, and clarity of the user's manuals.

CONFIGURATIONS

We tested all the printers in a network configuration using a Compaq Deskpro 66M network file server with 16 MB of RAM and Novell NetWare 3.12 installed on the hard drive. For a PC workstation, we used a Dell Dimension XPS P75 with 8 MB of RAM running DOS 6.22 and Windows for Workgroups 3.11. Our network file server used an NE3200 EISA Ethernet adapter; the workstation used an Intel PCI EtherExpress Pro/100 Ethernet adapter.

Each network adapter is bound to a variety of protocols to ensure it connects with each printer's network interface card (NIC). Our technicians tested printers with a Mac interface on a Quadra 640AV workstation with System 7.1, 16 MB of RAM, and EtherTalk installed. We tested each printer with the drivers that were supplied or recommended by its vendor. We disabled all print servers, spoolers, and buffers during performance testing.

On the PC platform, we used an NSTL-designed Windows applet to launch test files to each printer. After the last page of a test file dropped into the tray, a tester pressed Enter; the applet then displayed the number of seconds it took the printer to print the file. We used a similar applet to measure EtherTalk performance. On the PC platform, we tested printers in both PCL and PostScript emulations; on the Mac platform, we tested printers in PostScript only. Tests in both emulations were run with the printer set to its highest resolution.



Using NSTL's network-printer-performance test-bed, project manager Jim Kane evaluates printer performance, quality, features, and ease of use.

Contributors

Michele Guy, Project Manager/NSTL, *has been testing hardware and software products for NSTL for the past four years.*

Tarig Imbrahim, Tester/NSTL, *has been an independent network consultant for the past five years.*

Jim Kane, Project Manager/NSTL, *has been testing network and PC hardware at NSTL for the past six years.*

John McDonough, Technical Editor/NSTL, *has been writing for high-tech publications for several years.*

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ROLL CALL

	DATAPRODUCTS CORP. TYPHOON 16	**DATAPRODUCTS CORP. TYPHOON 30**	**DIGITAL EQUIPMENT CORP. PRINTSERVER 17/600**	**HEWLETT-PACKARD CO. LASERJET 4MV**	**HEWLETT-PACKARD CO. LASERJET 4SI MX**
Price as tested	$3699	$29,616	$5390	$3549	$5299
MONOCHROME PERFORMANCE (PPM)					
PostScript	7.0	10.5	4.9	8.3	9.4
PCL	6.7	11.1	6.4	10.6	10.7
EtherTalk	6.6	7.9	N/A	7.6	7.1
PERFORMANCE SCORES					
Quality	8.3	7.6	7.7	8.1	7.9
Features	8.1	7.3	5.3	7.0	7.1
Usability	8.4	8.3	5.0	8.2	8.3
Overall	7.2	6.8	5.9	8.4	8.4
MEMORY					
Memory as tested (MB)	12	24	20	12	10
Memory base/maximum (MB)	12/68	16/32	16/32	12/44	10/26
Engine model	Fuji-Xerox Haruna	Hitachi	Canon 174-PCB	Canon P380	Canon MXP174
Maximum resolution (vertical/horizontal; in dpi)	600/600	400/400	600/600	600/600	600/600
ppm monochrome at maximum resolution*	16	30	17	16	17
INPUTS					
Auto-switching between inputs/emulations	●/●	●/●	○/●	●/●	●/●
Monthly duty cycle (pages)	30,000	200,000	70,000	50,000	75,000
Interfaces as tested	LocalTalk, Ethernet, SCSI, Centronics, RS-232, RS-234	Ethernet	Ethernet	LocalTalk, Ethernet, Centronics, HP BiTronics Parallel	LocalTalk, Ethernet, Centronics, HP BiTronics Parallel
INTERFACES					
RS-232/RS-422	●/●	●/●	○/○	Opt./Opt.	Opt./Opt.
SCSI-1/SCSI-2	●/●	○/○	○/○	○/○	○/○
Ethernet/LocalTalk/Token Ring	Opt./●/Opt.	Opt./○/○	●/○/○	●/●/Opt.	●/●/Opt.
PDLS					
HPGL	●	○	○	●	●
PostScript Level 1/Level 2	○/●	●/○	●/●	○/●	○/●
PostScript/Vendor	●/Adobe	●/Phoenix	●/Adobe	●/Adobe	●/Adobe
Intellifont	●	●	○	●	●
True Image	●	●	○	○	○
HP LaserJet III (PCL5/PCL4)	●/●	●/●	●/●	○/○	○/○
SUPPORTED PAPER SIZES					
Letter (8.5 × 11 in.)	●	●	●	●	●
Legal (8.5 × 14 in.)	●	●	Opt.	●	●
A4 (8.26 × 11.69 in.)	●	●	Opt.	●	●
B5 (7.17 × 0.12 in.)	●	○	●	●	●
Tabloid (11 × 17 in.)	●	●	○	●	○
Executive (7.25 × 10.5 in.)	●	○	Opt.	●	●
Number of input trays standard/maximum	1/3	3/5	2/3	2/3	2/3
Envelope tray	●	○	Opt.	●	●
Envelope/transparency/ adhesive-backed labels	●/●/●	○/○/●	●/●/●	●/●/●	●/●/●
Envelope feeder	Opt.	○	Opt.	●	●
Duplex printing	○	●	●	○	Opt.
Dimensions in inches (W × L × H)	17 × 23 × 11	26 × 25 × 40	17.9 × 22.4 × 19	18.1 × 20.6 × 12.5	21.5 × 23.5 × 16.5
Weight (lbs.)	42	132	98	51	94
FCC class/noise in high-speed draft mode (decibels)	A/53	A/55	A/50	B/55	B/55
Energy Star–compliant	●	○	●	●	●
Voltage	120	120	120 or 220	220	220
Warranty (years)/coverage	1/P, L	90 days/P, L	1/P, L	1/P, L	1/P, L
Phone	(703) 648-0930	(703) 648-0930	(508) 493-5111	Call local HP dealer	Call local HP dealer
Toll-free phone	(800) 980-0374	(800) 980-0374	(800) 777-4343	(800) 752-0900	(800) 752-0900
On-line address	http://www.dpc.com	http://www.dpc.com	http://www.digital.com	http://www.hp.com	http://www.hp.com
Inquiry number	**1396**	**1397**	**1398**	**1399**	**1400**

= BYTE Best.

● = yes; ○ = no; N/A = not applicable.

*Scores for monochrome performance are actual, real-world performance scores.

Warranty:
P = Parts L = Labor F = Freight to repair center R = Return to customer

KYOCERA ELECTRONICS, INC. ECOSYS FS-3600A	KYOCERA ELECTRONICS, INC. ECOSYS FS-3400A	LEXMARK INTERNATIONAL OPTRA LX	QMS, INC. 1660E PRINT SYSTEM	QMS, INC. 3225 PRINT SYSTEM	XEROX CORP. 4520MP DESKTOP LASER PRINTER	XEROX CORP. 4230/MRPÅ
$4278	$3578	$3997	$6798	$17,149	$4335	$20,245
10.0	N/A	5.3	7.5	14.6	8.9	12.9
9.4	11.7	7.1	9.5	19.2	11.4	12.5
9.5	N/A	4.9	6.9	12.8	7.4	9.2
7.8	7.9	8.8	8.2	7.8	8.0	7.1
6.1	6.0	6.7	7.0	7.7	6.7	7.9
8.0	8.0	8.7	8.8	8.5	8.3	8.9
6.3	8.7	7.1	8.1	9.0	8.7	7.3
6	5	12	48	16	12	20
2/66	1/5	4/64	12/64	16/32	8/52	20/20
Kyocera FS-3600	Kyocera FS-3400	Lexmark Optra	Canon BX II	Ricoh M32	Fuji-Xerox XP-20	Fuji-Xerox 4230/MRP
600/600	1200/300	1200/1200	1200/1200	400/400	800/800	300/300
18	18	8	16	32	20	30
●/●	●/●	●/●	●/●	●/●	●/●	●/●
50,000	50,000	75,000	35,000	200,000	75,000	230,000
Ethernet, Centronics	Ethernet, Centronics	Ethernet, Centronics, RS-232, RS-234	Ethernet, SCSI, AppleTalk, RS-232	Ethernet, Centronics, Centronics, AppleTalk, RS-232	Ethernet, RS-232, RS-234	LocalTalk, Ethernet, Centronics, RS-232
Opt./Opt.	Opt./Opt.	●/●	●/○	●/○	●/●	●/○
○/○	○/○	○/○	●/○	●/●	○/○	○/○
Opt./Opt./Opt.	Opt./Opt./Opt.	Opt./Opt./Opt.	●/Opt./Opt.	Opt./●/Opt.	●/Opt./Opt.	Opt./Opt./Opt.
●	●	●	●	●	○	○
Opt./○	Opt./○	●/●	●/●	●/●	○/●	○/●
○	○	○	●/QMS	●/Adobe	●/Adobe	●/Adobe
●	●	●	Opt.	N/A	●	●
●	●	○	○	○	○	●
●/●	●/●	●/●	●/○	●/●	●/○	●/○
●	●	●	●	●	●	●
Opt.	Opt.	Opt.	●	●	Opt.	●
Opt.	Opt.	●	●	●	Opt.	●
Opt.	Opt.	●	●	●	Opt.	●
○	○	○	●	●	●	●
●	●	●	●	●	Opt.	●
1/4	1/4	1/3	3/2	2/3	4/5	5/5
●	●	Opt.	○	○	●	●
●/●/●	●/●/●	●/●/●	○/●/●	○/●/●	●/●/●	●/●/●
Opt.	Opt.	Opt.	○	○	Opt.	●
●	●	●	○	●	○	●
13.6 × 13.8 × 9.7	13.6 × 13.8 × 9.7	16.1 × 21.1 × 17.2	18 × 23.2 × 11.8	37.4 × 25.8 × 29.5	20.5 × 22 × 20.8	39 × 26.7 × 41.7
23	23	50	N/A	187	83	356
B/50	B/50	B/50	B/N/A	A/<55	B/53	A/55
●	●	●	●	○	●	●
120	120	120	120 or 220	120 or 220	120 or 220	220
1/P, L, F	1/P, L, F	1/P, L, F, R	1/P, L	90 days/P, L	1/P, L	3 months/P, L
(908) 560-3400	(908) 560-3400	(606) 232-2000	(334) 633-4300	(334) 633-4300	Call local Xerox dealer	Call local Xerox dealer
800) 232-6797	(800) 232-6797	(800) 891-0331	(800) 523-2696	(800) 523-2698	(800) 349-3769	(800) 349-3769
ohn_storch@kei-us.cc: nail.compuserve.com	john_storch@kei-us.cc: mail.compuserve.com	http://www.lexmark.com	http://www.qms.com	http://www.qms.com	N/A	N/A
1401	1402	1403	1404	1405	1406	1407

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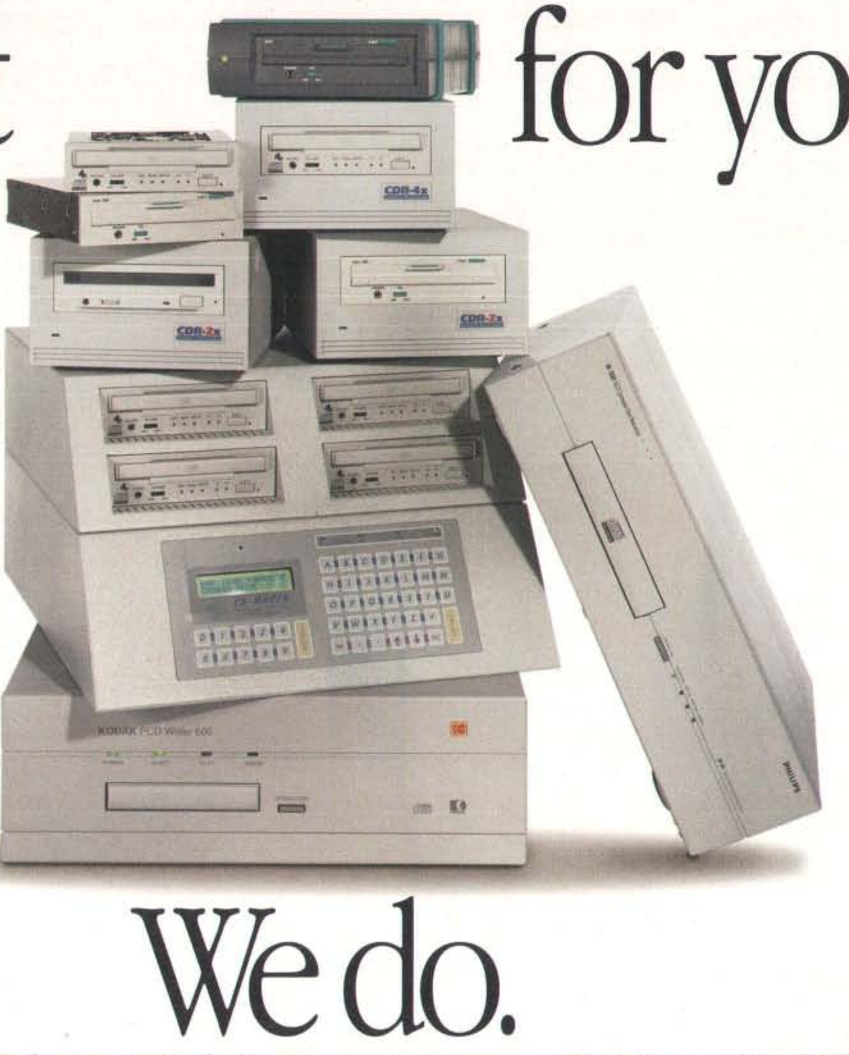

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PixelFlow: Scalable Image Processing

It divides and conquers rendering by drawing the objects first, then combining them

DICK POUNTAIN

PixelFlow is a new chip architecture for generating photo-realistic images in real time. Created by researchers at the University of North Carolina, PixelFlow is aimed squarely at the very top end of the graphics market, presently dominated by such exotic hardware as Silicon Graphics' RealityEngine^2 (see "Damn the Torpedoes!," November 1993 BYTE). To compete in this arena, a system must offer full color (with fog and transparency effects), high resolution, photo-realistic Phong shading, antialiasing, and bump- and texture-mapping, all while delivering up to 60 video frames per second.

The sort of customers who can afford this high level of realism right now include Hollywood studios chasing another *Jurassic Park*-class blockbuster film, and military departments. The latter is looking into PixelFlow for use in sophisticated VR combat simulators (research on PixelFlow has been partly supported by the U.S.'s Defense Advanced Research Projects Agency).

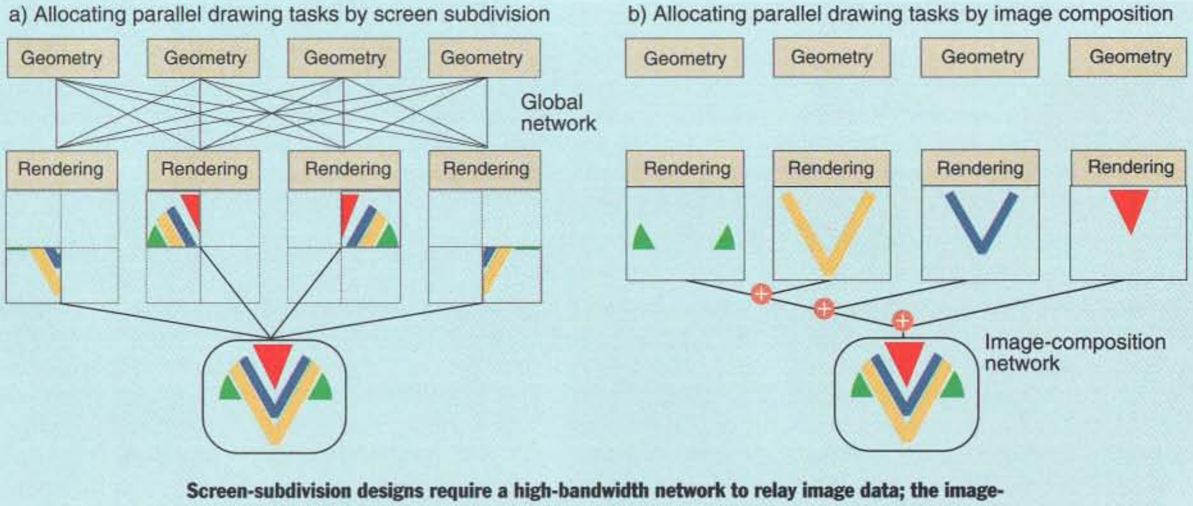
PixelFlow shares some of the same design decisions that went into the RealityEngine^2. First, it employs massive parallelism, since there's no way to get sufficient bandwidth from a single processor. Second, it separates the floating-point-intensive geometry processing from the rendering process, which uses high-performance integer calculations. This is explained by the fact that geometry processing works on a database of real numbers—the 3-D coordinates that describe objects—using matrix math. These calculations transform this data into a current screen view composed of triangles. Conversely, rendering works on bit maps at the pixel level, coloring in the triangles to give the illusion of a scene with lighting and shadows.

Where the PixelFlow architecture differs from its competitors is that it's fully scalable in both the geometry and the rendering dimensions. It splits the rendering process itself into separate rasterizing and shading steps (so-called "deferred shading") that are implemented on separate boards. A PixelFlow system consists of a backplane into which you can fit the appropriate mixture of rendering and shading boards to achieve the performance you require (see the figure "PixelFlow Hardware" on page 250).

Subdivision vs. Composition

Key to PixelFlow's scalability is the way it distributes tasks among its parallel processors, using a technique called *image composition*. The more obvious way to distribute graphics tasks is through *screen subdivision*, where you divide up the screen into a number of nonoverlapping regions and assign a different renderer to each region. This approach scores on conceptual simplicity but complicates implementation. Most of the objects in any

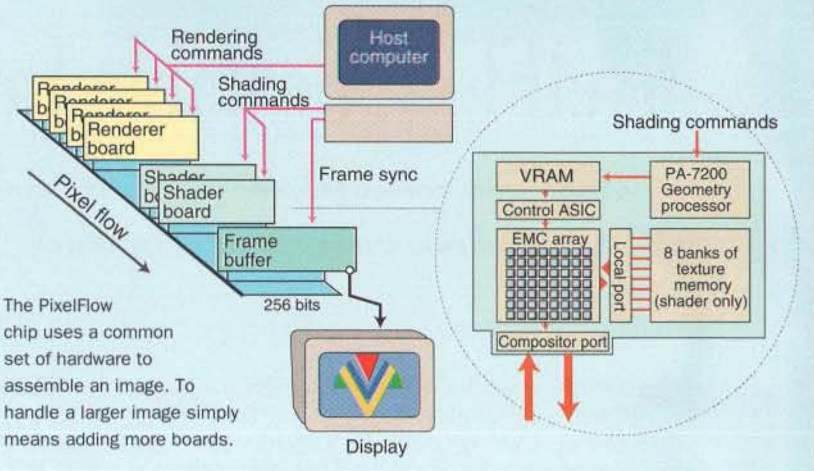
Imaging Architectures Compared


a) Allocating parallel drawing tasks by screen subdivision

b) Allocating parallel drawing tasks by image composition

Screen-subdivision designs require a high-bandwidth network to relay image data; the image-composition design relays only the data for the object it has rendered and composited.

PixelFlow Hardware



The PixelFlow chip uses a common set of hardware to assemble an image. To handle a larger image simply means adding more boards.

scene will cross region boundaries, and they'll also move around the screen as the viewpoint changes. Hence, a global routing network is needed so that any geometry engine can deliver objects to any renderer (see section (a) of the figure "Imaging Architectures Compared" on page 249). This network needs a very high bandwidth and, crucially, the bandwidth required rises with the rendering rate. Having to sort the drawing primitives by screen region also complicates software implementation.

In image composition, by contrast, each graphics processor works over the whole screen area but renders only some of the primitives (see section (b) of "Imaging Architectures Compared"); the partial images so produced are then composited (hence the name) into a single picture. This does away with the global switching network completely, as each geometry engine always serves the same renderer. Instead, you need a compositing network to combine the partial images; however, as this carries only local traffic from each renderer to its neighbor, its necessary bandwidth (though still high) remains constant as you add more renderers. Therefore, you have scalability.

Composition-network bandwidth depends on the screen size and frame rate. Say we want a 1280- by 1024-pixel image that's 48 bits deep, displayed at a 30-Hz frame rate. This amounts to a base bandwidth of 2.3 Gbps. In PixelFlow, however, antialiasing requires each pixel to be super-sampled four times over, and the deferred shading algorithm multiplies the required bandwidth further by a factor of 2 or 3. The architecture that handles these operations is based on a 256-bit-wide image-composition network running at 132 MHz, for a total of 33.8 Gbps. The very name PixelFlow stems from the fact that a stream of pixels flows in one direction along this compositing data path, with each rendering board adding its own contribution to the image as it passes through.

The compositing port on each board contains hardware comparators that implement a z-buffering scheme, so only those pixels that should be visible (that is, those pixels that have a smaller *z* coordinate and so are in front of any other pixel) pass over the network to the next renderer. This comparison hardware works in parallel, so that a board can be rendering the next frame while the current one is passing over the network.

"Deferred shading" implies that the renderers don't generate final RGB values. They generate an intermediate pixel representation that encodes attributes such as intrinsic color, direction of surface normals, and texture coordinates. These intermediate values flow into the shaders (all located downstream from the renderers) where they are converted to RGB using shading and texturing algorithms. The last station on the network is the frame buffer, where the final composited image accumulates.

PixelFlow Hardware

At the heart of the PixelFlow architecture is a processing array of enhanced memory chips (EMCs), which you can think of either as a single-instruction multiple-data parallel computer or, equivalently, as an intelligent memory. This EMC, for which first silicon is due this quarter, is the latest in a family of UNC designs called Pixel-Planes. It's a 16 by 16 array of cells, each of which consists of an 8-bit ALU, a linear expression evaluator, 2048 bits of local memory to store pixel data, and an 8-bit memory bus. The linear expression evaluators compute the value of bilinear expressions of the form Ax+By+C for each cell's *x,y* coordinates. The ALUs perform arithmetic (including 16-bit multiplies) and logic operations on the cell's pixel data, in parallel across the whole array.

Programming involves broadcasting the parameters A, B, and C for each of the three corners of a triangle to the whole array, along with an ALU micro-instruction specifying an operation. All the cells compute in parallel whether their own pixel lies within this triangle ($A1x+B1y+C1<0$, etc.) and perform the requested operation if the pixel does.

This EMC array is equally useful for rendering or shading operations, so all PixelFlow boards contain the same core components: a floating-point RISC geometry processor and an array of EMC chips. The EMC array is dual-ported. One port connects to the composition network. The second port is used differently, according to the type of board: On a renderer board it's unused; on a shader board it connects to eight banks of RAM used for storing texture maps; on a frame-buffer board it connects to the frame buffer itself. Since shading and frame-buffer boards perform no geometry calculations, their underused RISC processors can be redeployed for image-processing operations, such as warping, and for procedural texturing (running Renderman, for example.)

While it would be nice to provide enough EMCs to render the whole screen in parallel, this would currently be prohibitively expensive, as you'd need 5120 (80 by 64) EMCs per board. Real PixelFlow systems will use just 64 EMCs per board and render the screen as a time sequence of 128- by 128-pixel regions. This image sequencing, and that associated with antialiasing sampling, is performed by a custom control ASIC.

PixelFlow is now poised to enter the commercial arena. Division Inc. (Bristol, U.K.), a firm specializing in virtual reality systems, has formed a partnership with UNC to develop a PixelFlow board set, and Hewlett-Packard has invested in this project with an option to use the system in future graphics workstations. Consequently, Division has chosen HP's own PA-7200 (250+ SPECfp92) as the geometry processor (to be replaced when available by the PA-8000). The performance target—for a system with 128 PixelFlow boards—is 100,000,000 Phong-shaded, antialiased, textured triangles per second. ■

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Open(ing) VMS to Win32

Adding Win32 support to Digital's OS will allow developers to target OpenVMS and NT machines

MARK FENIELLO

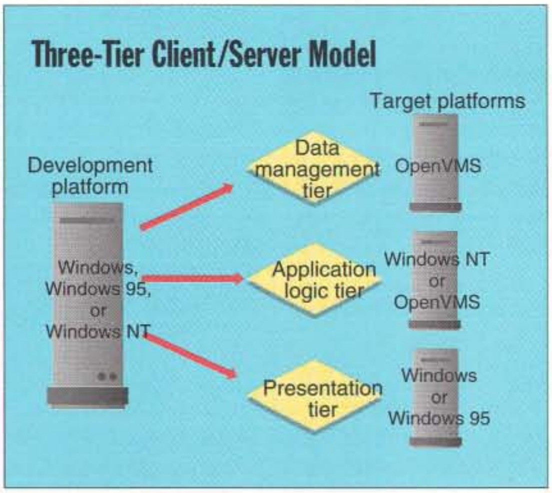
Good things come to those who wait. Digital Equipment Corp. and Microsoft have had an agreement for several years to help each other develop, promote, and market products. Soon after this relationship was formed, Digital's Alpha AXP machines were among the first to support Windows NT. Since then, however, there have been few tangible results to support the flurry of marketing and PR announcements. But finally this alliance is starting to bear real fruit.

The two companies have agreed to exchange engineers, license some of each other's patented technology, and provide access to each other's source code. And Microsoft will fund the training of at least 1500 Digital employees to support Microsoft products. But perhaps the biggest news is Digital's announcement that its OpenVMS operating system will soon support Microsoft's Win32 API.

Word for OpenVMS?

So does this mean Microsoft Word will run on OpenVMS? That's a question Wes Melling, Digital vice president of OpenVMS Systems Business, hears often. And his answer is "No." The long version of the answer is that when enough of the Win32 API is supported by OpenVMS, you could get Word to run under OpenVMS by recompiling and relinking the source code. That is not likely to be a high priority for either Microsoft or Digital, so Melling is probably right; the answer remains "No."

On the other hand, many OpenVMS developers want to know if they can now develop Windows applications and then run them on an OpenVMS system. This is the question Digital wants to hear, because the answer is a resounding "Yes." Digital wants developers to build applications for Windows and then keep OpenVMS in mind when deciding which platforms to support with these new applications. This is the message Digital must keep telling developers as desktop machines play an ever-increasing role in the day-to-day business operations of Digital's traditional user base—medium to large scientific and commercial sites.



OpenVMS with Win32 will enable developers to deploy three-tier client/server applications.

The announcement of OpenVMS support for the Win32 API is part of a much larger picture Digital is painting. OpenVMS is already widely accepted as a bulletproof operating system capable of providing 24-hour-a-day, 365-day-a-year reliability to business-critical, enterprise-wide applications. But Digital knows that business desktops are dominated by PCs, most of which are running Windows. Digital wants to make it easier for developers to create client/server applications for a single OS (i.e., Windows) and then deploy those applications on a combination of Windows, Windows NT, and OpenVMS systems.

The Three-Tier Approach

Digital and others in the industry are now promoting a new model for client/server applications. They are warning that applications with a "fat client" or a "fat server" will not scale or perform well in the future.

An application with a fat client is one in which the client handles not only the user interface but most of the application's decision logic as well. This leaves only the data-retrieval and update functions to the back-end server. A fat server application results when the client is little more than a GUI that issues SQL requests to a database server. In this type of application, the server handles most of the decision logic and calculations. The server then sends packets of formatted information back to the client for display.

Some analysts and makers of development tools are now advocating a three-tier client/server model (see the figure). In this model, the decision logic and heavy calculations are separated from the rest of the application and put into a partition of their own. This becomes the middle tier of the three-tier model. The first tier contains only the presentation services, the GUI. The third tier provides all the data management services.

With an application partitioned in this way, you have the flexibility to deploy each piece of the application on the system that gives it the best performance. Instead of running a CPU-hogging number cruncher on a 66-MHz 486, let it rip on a blazingly fast 275-

MHz Alpha AXP system. If you have to work with huge amounts of data, why try to cram a small piece of it into the 8 MB on the desktop client when you could fit everything into memory at once by accessing 512 MB of shared memory on an application server?

Some development tools take this even further by allowing you to replicate the application logic across multiple servers. With this configuration, automatic load balancing can be performed, letting the application server with the most available resources handle the clients' requests for services. Having multiple application servers also provides another benefit: Even if one or more servers goes down, requests can still be processed by the remaining servers. You can quickly envision a system that is as fast and as reliable as you want to make it. All you need to do is throw more hardware at the problems until there are no more problems left to solve.

Win32 API Support on OpenVMS

Expected Release Time	Features Supported
Now to 3 months	Win32s API, OLE 2, Microsoft Foundation Class
6 to 9 months	Selected Win32 Server API calls
12 to 24 months	Remaining Win32 Server API, BackOffice API

Platform Oblivious

If you are a developer, you may wonder what hoops you have to jump through to get a program to work like this. That is one of the main reasons that Digital is building support for the Win32 API into OpenVMS. It is already possible for you to build and partition a client/server application using the three-tier model, and you have a number of development tools to choose from to help you. The problem comes when you need to choose the target platform.

With most of the existing tools, you need to be very aware of the target platform for which you are writing the application. If you don't continually take this into account, your beautifully designed program will probably not run properly when it gets to the target system. According to Digital's Melling, it is Digital's goal to make things so transparent that the developer can be "platform oblivious."

By supporting the Win32 API on OpenVMS, Digital has brought developers one step closer to being "oblivious." You will be able to develop a client/server application on a Windows or Windows NT machine and then deploy it on any combination ofWindows, Windows NT, or OpenVMS systems.

Support for the entire Win32 API will not come all at once (see the chart above). First, Digital will support what Microsoft used to call the Win32s subset of the API. This portion of the API provides everything needed by a typical Windows program, such as I/O functions, memory management, and object management, plus the common graphics- and window-management calls. By the time you read this, support for the Win32s portion of the API, along with support for OLE 2 and the Microsoft Foundation Class, should be available. Within six to nine months, some of the Win32 server API calls will be supported.

Digital is now in the process of surveying customers as to which calls are most important and should be included in this second phase of support. Then, in the next 12 to 24 months, Digital intends to support the rest of the Win32 server API calls as well as the BackOffice API.

Presto Change-o

Bristol Technologies (Ridgefield, CT) is performing the magic that allows OpenVMS to understand and handle the Win32 API calls. Bristol is writing a library of callable routines that translate the Win32 API calls into the appropriate OpenVMS system services. The routines translate GUI-related API calls into their equivalent Motif calls. To enable an application designed for Windows to run under OpenVMS, you simply recompile your source program on an OpenVMS system and link it with this library. Except for minor differences between the Motif and Windows interfaces, you shouldn't know or care about the operating system on which your application is running.

It will take benchmark tests to determine comparative performance figures based on real applications. But Digital expects that performance will be almost identical between a Windows application running under Windows NT and the same application running under OpenVMS on the same hardware. Mike Cuccia, director of OpenVMS marketing at Digital, says that application performance on an OpenVMS platform is within 10 percent plus or minus of the performance on a comparable NT platform. Some calls are faster under OpenVMS and others are slower, so the performance of your specific application will vary depending on what it does.

Large applications that can be scaled over multiple processors can benefit from the better symmetric multiprocessing performance of OpenVMS. Windows NT tops out at three or four processors, while OpenVMS can go up to 10 or 12 processors. Another potential benefit of OpenVMS is that it will soon support 64-bit memory addressing. If your application manipulates massive amounts of data, you could see performance increases of up to 200 times by being able to get all the data into memory at once instead of having to bring it into memory in smaller pieces.

Digital expects that most client/server application development will continue to be done on Windows or Windows NT platforms. The company is therefore concentrating on making its OpenVMS development tools integrate with existing Windows development tools. Digital is making its compilers compatible with Microsoft compilers and is porting its development tool set to run under Windows NT.

Digital is working with other development-tool makers to ensure that these tools integrate well with Windows clients and OpenVMS servers. Some of these third-party environments help the developer with both the design process and the complex task of partitioning the final application. These environments insulate the developer from the underlying hardware and OS dependencies. Their ultimate goal is allowing the developer to concentrate on the application. The details of splitting the source code into different parts for compiling and deploying on different OS platforms will all be handled automatically by the development environment.

For years, OpenVMS has proven to be a secure, highly reliable OS for mission-critical applications. If Digital can pull off the integration of OpenVMS with Win32, it will have a powerful argument to convince developers of future client/server applications that they should continue using Digital's operating system. ■

Mark Feniello has worked with various Digital systems, including OpenVMS, for 15 years. He is currently a systems analyst for Spokane Computer in Spokane, Washington. He can be reached c/o editors@bix.com.

Windows NT Threads

To truly reap the rewards of a multiprocessor NT system, you have to use threads

SHASHI PRASAD

Multithreading (MT) is becoming increasingly attractive for applications; it offers one of the best choices for harnessing the power of SMP (symmetric multiprocessing) machines. In my article "Weaving a Thread" (October BYTE), I discussed multiprocessing and MT on Solaris and Windows NT. In this article, I'll take a closer look at the Win32 interface in Windows NT for developing MT applications.

Processes and Threads

A *process* in NT is a running instance of an application; it has its own virtual address space and owns system resources, such as memory, windows, and open files. When a process is created by a call to `CreateProcess`, an initial thread is automatically built for the process. You create additional threads by calling the following function:

```
HANDLE CreateThread(LPSECURITY_ATTRIBUTES lpsa,
   DWORD cbStack,
   LPTHREAD_START_ROUTINE lpStartAddr,
   LPVOID lpThreadParm,
   DWORD fdwCreate,
   LPDWORD lpIDThread);
```

The newly created thread starts executing the routine specified by `lpStartAddr`, and this routine can take the optional argument `lpThreadParm`. The thread-routine argument is generally a dynamically allocated variable or a global variable. Each thread in NT has its own user and kernel stack, and the size of the stack for the newly created thread can be specified in `cbStack`.

Threads in NT have 32 different priority levels. The *dispatcher*—the module responsible for thread-scheduling—uses a preemptive priority scheduler. In Windows NT, the highest-priority thread is always scheduled to run. Threads can change their priority by calling the function `SetThreadPriority`.

NT threads can be suspended and resumed by other threads in the process via calls to `SuspendThread` and `ResumeThread`, respectively. You can also create a thread in suspended state, which means it doesn't start execution until the creating thread calls `ResumeThread`.

A thread can terminate in one of the following ways: It can return from the initial routine; it can call the function `ExitThread` to terminate itself; or it can be terminated by some other thread in the process that calls `TerminateThread`. When a thread terminates, the thread object becomes *signaled*—all other threads waiting for the thread to terminate are notified. A waiting thread can determine the exit status of a terminated thread with the function `GetExitCodeThread`.

Each thread has a unique identifier that can be retrieved by calling the function `GetCurrentThreadId` (this identifier is also returned in the `lpIDThread` argument during thread creation). However, several Win32 functions require an object's handle, which, for a thread, is separate from its ID. The handle to the thread object can be retrieved by calling the function `GetCurrentThread`. (The handle is also returned by the function `CreateThread`.) For example, when a thread wants to change its priority class, it can call the following:

```
SetThreadPriority(GetCurrentThread(),
THREAD_PRIORITY_LOWEST);
```

Thread Synchronization

In a multithreaded program, all threads within the process run in a single address space. Threads allow easy data sharing; however, safeguards against corruption of the shared data are required. All access to shared resources must be protected by mutual exclusion.

In NT, mutexes are used to serialize critical sections of code. A *critical section* is defined as a segment of code in which a thread accesses shared, modifiable data, and where state changes happen over several instructions. Hence, only one thread can be executing that section at a given time. Access must be serialized by some form of locking mechanism.

Before entering the critical section, the calling thread acquires the mutex lock by calling the `WaitForSingleObject` function. If the lock is held by some other thread, the calling thread is suspended until the thread holding the mutex lock releases it by calling `ReleaseMutex`.

Critical-section objects are similar to mutexes but can be used only by threads of a single process. `EnterCriticalSection` is used to acquire ownership of a critical section, and `LeaveCriticalSection` releases ownership. This is one of the fastest mechanisms for mutual exclusion; only a few instructions are executed when there is no contention for the critical section. (If contention occurs, a kernel synchronization object is automatically used.)

In a multithreaded application, it's common to divide work among multiple threads. In such cases, one thread might wait for another thread to reach a particular state before proceeding. NT provides event objects for thread synchronization. One thread can call `WaitForSingleObject`, thus blocking its execution until a certain condition is satisfied. The other thread, after satisfying the condition, can notify the waiting thread by calling `SetEvent`.

Semaphore objects are similar to mutexes, except there is no ownership associated with semaphores. Additionally, semaphores have resource counts, which allows multiple threads to acquire a semaphore at the same time.

Finally, NT provides atomic memory operations for integer variables. The functions `InterLockedIncrement` and `InterLockedDecrement` increment and decrement a variable, respectively, while the function `InterLockedExchange` reads the value of a variable.

Threads and Performance

Once you've grasped the basic concepts of NT threads, you need to consider the performance and scalability of threaded applications. A thread in NT can normally be in one of the following states at any given time: waiting for a specified event to occur (it cannot run); ready to run and waiting for an available processor; or running on a processor.

Threads in the ready or running state can take advantage of the CPUs (presuming they are running on a multiprocessor system). Excessive interthread synchronization can cause too many threads to be in the waiting state, and the creation of too many threads can cause multiple threads to be in the ready state. The number of threads in the running state can never be more than the number of processors. When the number of threads in the ready state is much higher than the number of running threads, the kernel spends a lot of time doing thread-context switching.

As an illustration, consider the various threading models used in the design of a multithreaded TCP/IP server. (This assumes you're familiar with Windows socket APIs on Windows NT.)

The first model is single-threaded. The main thread does an accept call on the socket and handles the client request. The disadvantage of this model is that while the server is processing a client request, all other requests are being queued.

The second model is also single-threaded: The main thread does a *select* call on all the connected sockets. The select call indicates which connected sockets have data available (i.e., they are waiting to be serviced). Now multiple clients can be serviced concurrently, but—as in the previous model—this does not exploit the power of multiple CPUs.

In the third model, the main thread creates a thread for each client. This model is extremely easy to program, but it does not scale well for a high number of active clients. Creating multiple threads takes advantage of multiple processors but uses excessive system resources and causes scheduling overhead. The performance of the system degrades under "burst" traffic. As the number of ready threads increases, the system spends lots of time context-switching threads in and out of the running state.

Finally, in the fourth model, a pool of worker threads is created to handle client requests. The main thread does a select on all the connected sockets; each new request gets passed to one of the worker threads. The number of worker threads should be slightly greater than the number of processors, because some of the worker threads might become blocked.

This model uses less system resources than the third model, but there's a built-in context switch on every transaction between the main thread and the worker threads. The context switch might not be a problem for longer transactions, but the overhead could be high for short transactions. Also, unless the main thread does some rotation on the results of the select call, this model does not have built-in fairness (i.e., an active client may block other, less active ones).

I/O-Completion Ports

To overcome the limitations of these four models, the engineers of NT 3.5 created a mechanism called *I/O-completion ports*. These ports are designed to handle asynchronous or overlapped I/O. `CreateIoCompletionPort` associates a port with a collection of file handles, and the port acts as a synchronization point. When a pending I/O operation on any of the file handles completes, an I/O-completion packet is then queued to that particular port. A number of worker threads can manage I/O for clients by calling `GetQueuedCompletionStatus` to wait on the I/O-completion port.

SYNCHRONIZING THREADS

Mutex—Serializes access to shared data.

Critical-section object—Faster than a mutex; cannot be shared across processes.

Event object—Used to signal occurrence of an event.

Semaphore—Controls multithreaded access to a shared but limited resource.

Interlock call—Provides atomic access to integer variables.

I/O-completion ports have built-in concurrency control. The kernel tries to limit the number of runnable threads associated with a port, never to exceed the port's concurrency value (which is specified when the port is created). When a thread calls `GetQueuedCompletionStatus`, it returns when I/O is available. When one of the threads associated with a completion port is blocked, the kernel selects another thread waiting on the completion port to run. Thus, the system isn't deluged with runnable threads.

Threads that block on a completion port are awakened in last-in/first-out (LIFO) order, while I/O requests are serviced in first-in/first-out (FIFO) order. Running threads—after completing a transaction—can pick up the next request without causing any context switch. I/O-completion ports work efficiently under all loads; their performance does not suffer under heavy traffic.

If my sample TCP/IP server were implemented using I/O-completion ports, the main thread would create an I/O-completion port along with a pool of worker threads to wait on the port. This model is the most efficient; it does not suffer from context-switching overhead (as the fourth model would). The thread that reads the transaction services it. Fairness is built into the completion-port model, since I/O requests are satisfied in FIFO order.

The Common Thread

MT on an SMP machine can provide optimal performance and scalability if the applications are designed correctly. You should not be surprised to see poorly designed applications run slower on an SMP machine than they do on a uniprocessor machine.

Windows NT is a good environment for developing multithreaded applications, but it's important to remember that the OS alone is not responsible for performance and scalability. Understanding such features as I/O-completion ports and overlapped I/O are key to building scalable multithreaded applications on Windows NT. ■

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ATM with a Twist of LAN

LAN Emulation brings legacy LANs onto the ATM bandwagon

REX BALDAZO

LAN Emulation (LE) may be the killer application that brings asynchronous transfer mode (ATM) networking into the mainstream. ATM is a fast, modern networking technology that is considered by many to be the biggest thing since Ethernet (see "On the Road to ATM," September 1994 BYTE). But corporations with huge investments in mission-critical applications running on Ethernet and Token Ring networks have been loath to make the transition, slowing the acceptance of ATM.

The reason was simple—interoperability, or rather the lack thereof. Computers directly connected to an ATM network couldn't run legacy applications that depended on a LAN's unique properties. Instead, the only way to bring some of the benefits of ATM to legacy networks required devices such as Ethernet-to-ATM switches (see "Merging ATM and Ethernet," August BYTE). But perhaps ATM's biggest strength is as an end-to-end solution, connecting desktops across the enterprise—one network architecture, from LAN to WAN. LE is just the ticket, allowing legacy applications to run essentially unchanged, while also allowing the computers on which the applications run to be directly connected to the ATM network.

ATM was developed by telecommunications companies. It is based on fast ATM switches and is connection-oriented (see "All-Terrain Networking," August 1993 BYTE). In contrast, LANs such as Ethernet and Token Ring are based on a shared, not switched, medium, and the protocols are connectionless.

LE, which was developed by the ATM Forum's LAN Emulation Subworking Group, bridges the gap by hiding the underlying ATM network at the media access control (MAC) layer. This layer provides device-driver interfaces such as Open Data-Link Interface (ODI) and Network Driver Interface Specification (NDIS), so higher-level applications dependent on these protocols work without modification. A group of ATM stations acting as a traditional LAN is called an emulated LAN (ELAN).

Performing this magic requires four components: LAN Emulation Client (LEC), LAN Emulation Server (LES), Broadcast and Unknown Server (BUS), and LAN Emulation Configuration Server (LECS). (See the figure "Getting from Here to There.") The LEC resides on all ATM-attached stations (e.g., bridges and workstations) that are participating in the LE service. The three server components may reside on one ATM-attached workstation or on separate workstations. Some vendors may even implement one or more of the server functions inside an ATM switch.

The Client

The LEC is responsible for the MAC-layer connectionless service that hides ATM from LAN-based applications. In a basic configuration, each LEC possesses two addresses: an IEEE-format 48-bit MAC address and a 20-byte ATM address. If the LEC is running on a bridging device such as ATM-to-Ethernet, the LEC might have multiple IEEE MAC addresses for which it is responsible.

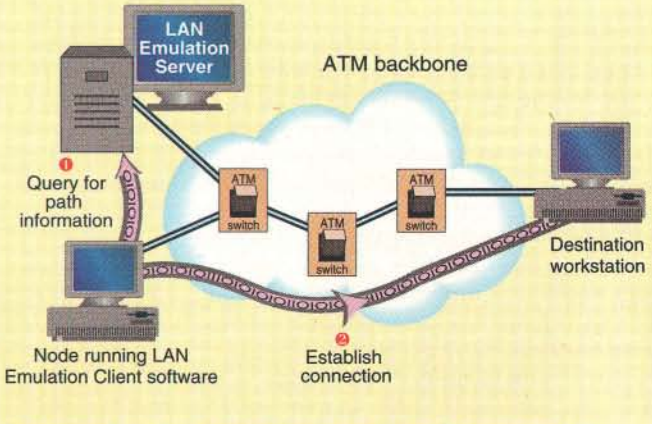
When a new outgoing message arrives from a higher-layer entity to the LEC, that message includes a MAC address for the intended destination. The LEC must translate that address into the appropriate 20-byte ATM address, establish a connection (if one is not already open), and transmit the message.

The LEC begins by looking at the connections, called Virtual Channel Connections (VCCs), it has open. The LEC maintains a translation table of destination MAC addresses to VCCs. If the destination address for the new message is in the table, the LEC can simply send the message using the existing VCC.

If the destination address is not in the translation table, the LEC has to perform an address resolution using the LAN Emulation Address Resolution Protocol (LE-ARP). It sends an address-resolution request to the LES. When the LEC receives back the valid destination ATM address, it performs standard ATM signaling to establish a VCC and transmit the message.

LECs are able to register their ATM-to-MAC address

Getting from Here to There



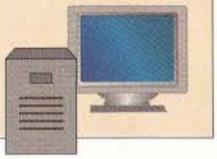
For two virtual LAN clients to make a connection, a client first queries the LAN Emulation Server for the destination client's asynchronous transfer mode (ATM) address. The server looks up the address and determines the appropriate path (over the ATM network) to that address.

translation with the LES. Then, when the LES receives an address-resolution request, it can reply directly with a message containing the matching ATM address. Otherwise, the LES must forward the message to the destination ATM station, which replies with the correct address.

Each LES entity represents one ELAN. On any ATM network, there might be multiple LESes maintaining independent networks. The LECS is responsible for maintaining configuration information about the various ELANs. An LEC is assigned to an ELAN based on the configuration stored in the LECS.

Key Components for ATM LAN Emulation

- **LAN Emulation Client—a software driver that runs on a network client**
- **LAN Emulation Server—maintains a mapping between ATM and LAN addresses**
- **Broadcast and Unknown Server—maintains lists of Virtual Channel Connections**



The BUS to Everywhere

When an LEC has a multicast or broadcast message to send, it does not know a priori the MAC addresses of all the recipients. Even if it did, repeatedly querying the LES and setting up an ATM VCC for each station would be wasteful of bandwidth and computing resources. The solution is the BUS.

During the initialization of an LEC, it has to determine the ATM address of the BUS. It transmits to the LES an address-resolution request for the broadcast address (hexadecimal FFFFFF) and receives back the ATM address for the BUS. The LEC must then establish a VCC to the BUS.

ATM supports a one-way point-to-multipoint broadcast mechanism. One station becomes the root. It sets up one-way VCCs to each receiving station. The BUS sets up such a tree, with the BUS as the root node and all stations of the ELAN as branches. This tree is maintained as long as the ELAN is in service. New LEC stations joining the ELAN are added to, and stations leaving the ELAN are pruned from, this broadcast tree.

Thus, the BUS has several two-way VCCs, one to each LEC, that are established during the initialization of each LEC. The BUS also maintains a one-way broadcast tree to those same LECs. Data to be broadcast from each LEC, as well as control information between the BUS and LECs, travels on the two-way VCCs. The BUS uses the one-way broadcast tree to send the actual broadcast messages.

It is important to mention here a limitation of the LE scheme. To achieve its high bandwidth, ATM relies on fixed-size packets called cells. An ATM cell contains 53 bytes (48 bytes of payload and a 5-byte header containing the VCC), an error-control code to protect the header, and some control bits.

The format of the payload is left up to what are called ATM Adaptation Layers (AALs). LE uses AAL5, which is the most efficient in terms of the 48-byte payload. Other AALs use part of each cell's 48-byte payload for things such as cyclic redundancy checks (CRCs) and sequencing numbers. This allows multiplexing different cell streams onto the same VCC, but it wastes part of every cell's payload. LE eschews such services by using AAL5, which breaks up an incoming message into 48-byte blocks and passes them onto the ATM physical layer for transmission.

The upside is efficient use of bandwidth. The downside is that the BUS is limited to sending out a broadcast message from only one LEC at a time. The BUS has to accumulate all the cells of a broadcast message, unpack them into the original frame to make sure a valid frame has been received, and repackage and send out the broadcast message. Incoming broadcast messages from other LECs must be queued up, awaiting their turn.

The LEC sends to the BUS all messages for which the LEC does not yet know the corresponding ATM address. This includes broadcast and multicast messages. However, it also includes any regular message whose destination address has not yet been received from the LES. This is where the "Unknown" component in the BUS acronym comes from.

As mentioned earlier, when an LEC has a message with an unknown destination MAC address, it transmits an address-resolution request to the LES. While awaiting the reply from the LES, the LEC does not sit idle. It begins transmitting the message to the BUS. If the LEC receives an ATM address from the LES, the LEC stops transmission to the BUS and connects directly to the destination station. Thus, some frames may arrive at a receiving station from a VCC connected to the BUS, and some from a VCC connected directly to the source LEC.

This may be undesirable in some cases. In a shared medium such as 802.3 and 802.5 LANs, frames will usually arrive in order. But in an ELAN, where some frames get sent via the BUS and some over a direct LEC-LEC connection, there is a real possibility the frames will arrive out of order. So the LE specification includes an optional flush protocol.

The sending LEC suspends transmission of the data frames and transmits a flush message down the old path, in this instance to the BUS. The BUS in turn broadcasts the flush message to all the stations in the ELAN. The destination station whose address matches the flush message replies to the flush. When the sending LEC receives this response, it begins transmitting again on the new path, in this case the direct VCC to the destination LEC.

Still on the Road to ATM

The success of technologies such as switched Ethernet and fast Ethernet is not due solely to technical merit. These technologies leverage the existing investment in software, providing greater throughput without requiring a total rewrite of all applications. This lesson has not been lost on the ATM Forum.

All the extra protocol baggage may seem like a lot of effort on the part of an ATM network just to accommodate old LAN software. But it is probably the key to the acceptance of ATM. It allows incremental deployment of ATM. You can replace the physical wiring of your existing LAN with an ATM network but keep existing applications intact. When you're ready, you can make the leap to applications that take full advantage of ATM.

Of course, dangers lie ahead. Early implementations of LE may have initial interoperability problems, as with any new specification. And because the specification leaves open the question of where the various servers reside—on one or multiple machines, or even in the ATM switch itself—there will be numerous solutions offered from numerous vendors. You may not be able to take one vendor's LES and another's BUS. Pick one vendor's solution and stick with it for now. It's going to be a minefield for the IS department, but with users clamoring for bandwidth, you will have to negotiate that minefield sooner or later. ■

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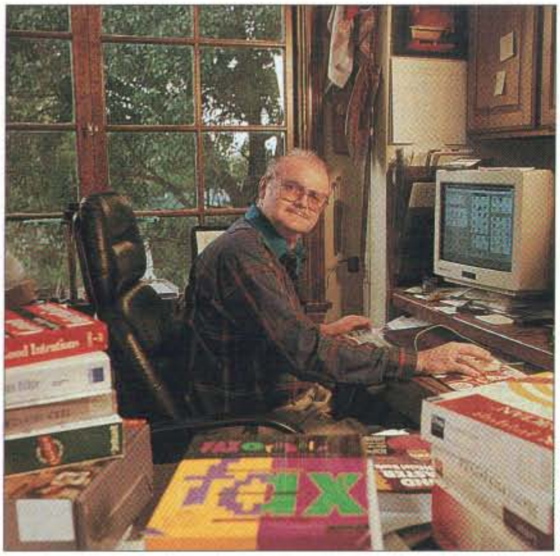
JERRY POURNELLE

Digital Models

I've just come back from Siggraph, the graphics convention, where the big theme was "see what's possible." The short answer to that is "practically anything."

The key word there is *practically*. We're a lot closer to Robert Heinlein's Adam Selene—a computer complex that became self-conscious and sentient when the networked hardware got complex enough in *The Moon Is a Harsh Mistress*—than I'd have predicted even five years ago, but we're not quite there.

They're pretty close with the graphics. The computer-generated humans at Siggraph look good from a moderate distance, but you can tell they're not "real" in close-ups. The expressions are good, but not quite good enough. Give it a few years, though, and I suspect you won't be able to tell whether you are looking at a live actor or a screen-generated person, even in love scenes. Is simulated sex and violence considered the real thing for ratings?



AMY ETRA © 1995

Digital images are available for everything from an Iowa-class battleship to Denzel Washington. Seeing is no longer believing.

MIT's Media Lab booth featured a computer-generated dog who could interact on-screen with a human. That is, the human stands in an open area and is seen by a camera. The human and the dog then appear life-size on a projection screen. The dog tries to get the human to play with him and will react to being petted. He'll bring you his ball, and when he's done something vigorous, he gets a drink of water.

Dog, ball, and water bowl are all computer images. The computer tries to be aware of the human, and the dog will generally avoid being stepped on. It's up to the human not to step on the spot onstage occupied by the nonexistent water bowl.

The dog interacts well with the human. If you encourage him, he rubs up against your legs; if you reject his advances, he becomes visibly sad. It's a long way from Adam Selene, but it's quite impressive.

On a more practical level, Viewpoint DataLabs has the 3-D Model Library CD-ROM, containing 3000 3-D video models. These aren't models of the sort we used to build out of balsa wood and tissue paper, but full 3-D CAD descriptions that can be put into a program like Macromedia Director.

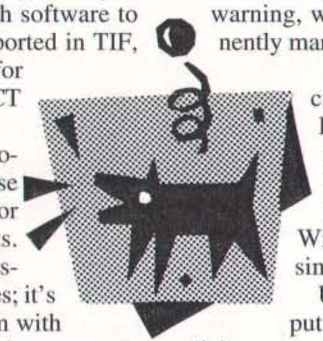
The models include civilian and military objects, creatures, a *Godzilla*-like movie set, and a partridge in a pear tree. These are very realistic—a Viewpoint T-38 video model was used for the flyover scene in the movie *Apollo 13*. (And if you haven't seen that film, go see it; it has some terrific computer-generated effects.) They also modeled Denzel Washington for *Virtuosity*.

Viewpoint DataLabs was giving away CD-ROMs of some of their models at Siggraph. Others are in the public domain and available for downloading. The best, of course, are for sale. Complexities range from relatively undetailed real-time models, such as a Los Angeles–class sub with 394 polygons, to an Iowa-class battleship with 30,113 polygons, to a model of what looks to me like the *Bounty* with 102,857 polygons. Viewpoint DataLabs' 3-D Model Library CD-ROM catalog is gorgeous. It's a lesson in the state of the art in image modeling.

For photo images, you aren't likely to do better than the Corel Stock Photo Library 2, which contains 200 CD-ROMs and 20,000 photographs

ILLUSTRATIONS: DIANNE BENNETT © 1995

on every imaginable subject, from the Grand Canyon to tall ships, bobcats and deer, highway signs and bobsledding, foliage and flowers, old master paintings—the list is endless. Software is included to let you use the photos as screen savers. Resolutions can be altered in a range from 128 by 192 pixels to 2048 by 3072 pixels. The library comes with software to allow the images to be exported in TIF, BMP, EPS, PCX, or GIF for Windows, and TIFF and PICT for the Mac.



These are all in Kodak Photo CD format, so you can use them to build slide shows or paste them into documents. They're royalty-free. I'm using mine to illustrate lectures; it's quite easy to integrate them with pictures I took myself. For that matter, I can, with programs like Adobe Photoshop or Macromedia Director, combine pictures and put myself into a better photo of me at the Leaning Tower of Pisa than I was able to take myself.

It's now possible to take pictures, have Kodak put them on a CD-ROM, read the digital image into a program like CorelDraw, alter it almost any way you like, put the image back on disc, and then print it. Want to see yourself shaking hands with President Clinton? Then add Newt Gingrich. Add angels, or trolls, as you prefer. Put clouds in the sky. It's all possible now. Seeing isn't believing anymore.

Even if all you want is eye candy, the Corel Stock Photo Library 2 is wonderful. Highly recommended.

Corel's box of 200 CD-ROMS cries for a good library program. I've got one, but first an aside.

I never sell evaluation software, and I'm pretty careful whom I give it to; schools, mostly. I suppose that's not true of every writer, but even so, I am constantly amazed at the lengths publishers will go to to protect their stuff. As an example: Aldridge has for weeks been trying to get me to look at CD-Cabin (with Link'N'Logging). Their PR people had already persuaded me, and the Corel Stock Photo Library 2 package was the clincher; but when I went looking for a copy, I couldn't find it. This was probably because I took it to the beach house with the intent of trying it there, got involved with fiction writing, and left it when I came back to Chaos Manor. In any event, I asked Aldridge to send another copy.

As usual, there was an "Evaluation Copy: Not For Resale" sticker on the outside of the shrink-wrap. In addition, there was another one inside the shrink-wrap. So far, nothing unusual—but inside the box, not only is the manual stamped in big red letters, but someone has written "EVAL" on the disk labels.

Of course, this makes me wonder whether what I have is really what my readers can buy. I presume it is, but fair warning, what I have is very prominently marked "EVAL."

Despite the terminally cute title, CD-Cabin with Link'N'Logging is a very useful program. Although it's a Windows 3.11 program, installation under Windows 95 (Win 95) was simple.

Using it is pretty intuitive: put a CD-ROM in your drive, click on new, and stand back. CD-Cabin scans the CD-ROM and builds a directory tree. Because Aldridge's Tree 86 was for a long time one of the best of the DOS directory shell programs, I expected this to work properly, and it does. While it's building the tree, it scans the program file extensions and builds a database of what's in there. Alas, there seems to be no way to cut and paste from it; CD-Cabin doesn't seem to be Windows-aware. I had to make notes by hand to tell you that it found 19 executable, no compressed, 141 graphics, 10 help, and five sound files on the Corel CD-ROM.

There's a nifty viewer that's quite fast for throwing visual images on the screen. It works with most popular image file formats. You can also use CD-Cabin to listen to sounds, including wave sounds. Fair warning, though: be sure you want to listen, because once CD-Cabin starts playing a sound, you have to either wait for it to end or turn off your computer.

The cataloging program has provisions for making volume (but not individual file) notes, as well as for creating program categories like OSes, utilities, games, accessories, and sounds. A CD-ROM can be associated with more than one category. You can also give each disc a Library ID and record not only when you got it, but where. All this stuff can be sorted in various ways. When it's all done, CD-Cabin builds a compressed database containing the catalog information and a directory tree with all the filenames.

Most of those filenames will not be useful. For example, Lightbinders' Darwin CD-ROM has such uninformative filenames as 000001.001, and a lot of CD-ROMs have a HELP.TXT file. The Library of the Future volumes, many of which contain the only copies of some works of literature, have no filename clues as to what their contents are, and thus neither does the CD-Cabin catalog (unless you make such a list as a comment). Still, this is about the best you can do without doing your own index.

CD-Cabin's data compression is pretty good, but the database can grow like anything if there are a lot of files on a disc. One Corel Art Show disc takes up nearly 100 KB for its catalog. I don't know how big a database I'll have after I put all 200 Corel Stock Photo Library 2 CD-ROMs through this wringer, but I expect it will be many megabytes.

Given the pile of CD-ROMs I have acquired, I desperately need some way to catalog them, and CD-Cabin is surely the easiest to use of any I have found. However, there's one major defect. The program only builds an on-line catalog; if there's any provision for printing a list of cataloged CD-ROMs, I haven't found it. Given the information this program stores, you wouldn't want a printed copy of everything, but a simple listing of titles, Library ID, and comments would be a useful thing to have. It wouldn't be all that hard to add. Given time, I suspect I could crack their compression code and write a BASIC program to print my list, but maybe they'll provide that in an update.

Given the infinity of weird formats that CD-ROMs use for their tables of contents and databases, I don't suppose there will ever be a program that can automatically catalog everything contained on a CD-ROM, although I sure wish someone would figure out how to do that and let me print an indexed list. Until then, Aldridge's CD-Cabin with Link'N'Logging is at least as good as anything else I've seen, and I expect to use it. It is limited, but it's also fast and convenient, and I had no problems with it in Win 95. Recommended, with hope for improvements.

I'd hoped to get through this column without logging yet another problem with Win 95, but that was not to be. In attempting to catalog my CD-ROMs, I inserted Strategic Simulation's The Definitive Wargame Collection CD-ROM. This is one of the better CD-ROM game collections.

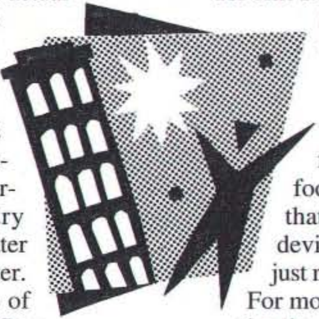
Alas, they've included a batch file for running the installation program, and Win 95 finds that and tries to run it—and you can't eject the silly CD-ROM until you run the installation program. I had to use a paper clip to release the CD-ROM carrier and pliers to pull it out of the drive; *nothing* I could do short of turning the machine off would make Win 95 release that disc.

Understand, these are mostly DOS

games, and Strategic Simulations didn't try to make it one of the famous Win 95 plug-and-play CD-ROMs; it just works out that they used a format that Win 95 recognizes that way. It sure was frustrating to try to catalog a disc and end up using a bent paper clip and pliers to get it out of the machine.

On the other hand, the game collection is excellent, and any two of the games are worth the price of the whole thing.

Models and Photo CDs, and images drawn with programs like CorelDraw, Macromedia Freehand, and AutoCAD are pretty standard for games and movies now. Some of the models are dynamic: *Jurassic Park* showed the way, and now a great many movies use computer animation scenes. Most of the space scenes in *Apollo 13* are computer-generated; the actual filmed footage looks like newsreels, not as realistic as what the computer can do. While a lot of *Waterworld* was filmed on an ultraexpensive location, the supertanker deck was on dry land, with the wide water vistas added by computer.



In its time, the state of the art for movies was *Star Wars*. Physical, not computer, models with stop-action camera work produced most of those marvels. Today, much of that would be done by computer, but for those interested in how things used to be, Ballantine Del Rey Books has a series called *The Art of Star Wars*, with photographs of the models, early sketches and paintings, portions of the scripts, cartoons, and spin-off art. They're good history, but what's striking is just how much of that can now be done with computers.

On that subject, LucasArts Entertainment has its LucasArts Archives Vol. I CD-ROM, which features a number of adventure and simulation games. These are all fancier games than those in Strategic Simulations' collection; if you like great graphics with lots of action sequences and sound, this is a pretty good collection. As games, I prefer Strategic Simulations' group, but there's no doubt at all that the LucasArts collection, which comes on six CD-ROMs, has better graphics. Like all Lucas games, these are clean fun, with no sex, and the violence is fairly muted.

Depending on the machine, some of my modems are faster than my serial ports. That is, with one machine, I can never connect faster than 9600 bps regardless of the modem or what service it's connected to. Doubtless this is a defective chip in the serial port. On the other hand, serial ports are inherently slower than parallel, and we're rapidly running up against their limits as modems get faster and faster.

Microcom has a remedy for this: use a parallel-port modem. Parallel ports are inherently faster than serial ports. Many communications programs assume serial connections, but that's no problem either. The Microcom DeskPorte Fast 28.8 modem (which also comes with a serial-port connection) comes with software that will fool your system into thinking it's communicating through serial ports. Of course, you can't have this attached to your LPT1 port and still print through that; but around here, all printing is done through LPT2, which is a network connection to the ValuePoint Pentium running OS/2 Warp as the print server. That works just fine.

Microcom's modem works pretty well. By the time you read this, they'll have drivers for OS/2 Warp and a way to fool Windows NT into believing that it's a serial communications device. Parallel communications is just new enough to have a few kinks. For most users, though, installation is simple, the modem locks on even to noisy lines, and you'll get true 28.8-Kbps communications if your telephone lines are clean enough. Most aren't, but the Microcom DeskPorte Fast 28.8 modem will get as much out of them as possible. I suspect that parallel-port modems are the wave of the future.

The gadget of the month is CoStar's LabelWriter SE200 Plus. It consists of a triangular box 8 inches at the base, 6 inches high, and 4 inches thick. It has its own power source and connects to the computer through a serial port. You load it with labels of whatever size you like—wide or narrow—install the printer drivers, and print labels.

I've had units that came with software to capture addresses or other printable data off the screen, but this is a kind of do-it-yourself kit: you get the unit, BASIC source code for all kinds of printer commands, some drivers, a programmer's guide, and the good wishes of the manufacturer. Doing label programs isn't difficult. The LabelWriter accepts escape codes that let you control margins, characters per line, and everything else you need. It will do bar codes and Proprinter XL graphics. It's pretty easy to connect this up with a database program.

continued

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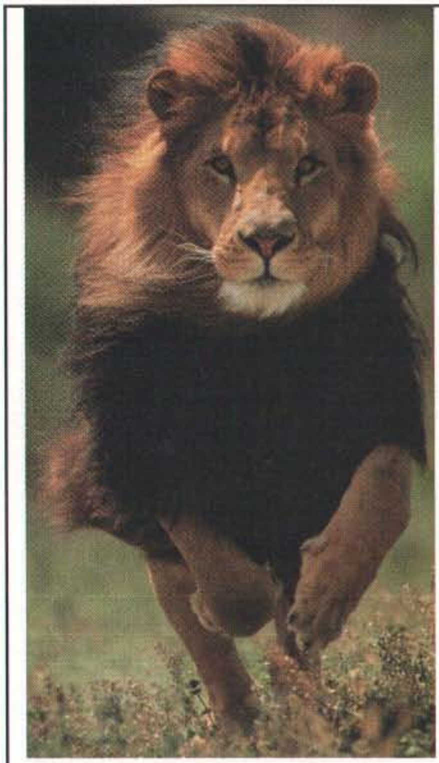

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-Communications Week, April 24, '95

"Frontier's SuperTCP [Suite] for Windows boasted the most applications of any product we tested, yet it was among the easiest packages to set up."

-Data Communications, Feb '95
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-LAN Magazine, April '95
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WHEN FAILURE IS NOT AN OPTION.

When failure is not an option for your client/server investment, you need power you can depend on. The LT Series uninterruptible power system represents a significant advance in UPS technology. The system utilizes Fuzzy Logic theory to provide a regulated output voltage over a much wider input fluctuation range, down to 50% of nominal input voltage, before resorting to battery power. This patented "Fuzzy Ranging™" feature greatly extends battery life and increases backup time during full power outages. Other competitive advantages of the LT Series UPS include:

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A small business could use this to generate disk and shipping labels complete with bar codes and serial numbers. This is one of those gadgets that not everyone needs, but if you need it, you need it bad.

I've just had another lesson, although I'm not sure what it means. I now have the final "gold" Win 95; I also have the "gold" Norton Utilities for Win 95. Both are on CD-ROMs.

Back in earlier builds of Win 95, I had an earlier version of Norton Utilities installed, and I liked it; there are a number of useful features, including Norton Unerase and Disk Doctor. However, the early beta version did something odd to my local network; removing Norton Utilities cured the difficulties. Since it was all beta-test software, it wasn't worth recording details.

About the time I had the final Win 95 running and all was stable, Symantec sent the final Norton Utilities. The installation seemed to go well, but to finish I had to restart the machine—and it would *not* restart. First, it said it couldn't open Explorer, then something else, then it offered to open Win 95 in "safe" mode, and then it crashed utterly and completely. I was dead.

When I installed Win 95, I made a start-up disk, so I tried it; nothing happened. Finally, I found an MS-DOS 6 boot-up disk, installed enough CONFIG.SYS that the system would recognize my CD-ROM drive, and reinstalled Win 95 from scratch. It took a long time. First, Win 95 Setup ran a DOS SCANDISK program, and it found about 25 MB of what it thought were corrupted files; it also said there were "long filename" problems, but I'd have to run Windows SCANDISK to fix those.

Eventually, DOS SCANDISK was done and Win 95 began to install. When it came up, it was in generic 640- by 480-pixel VGA mode and the network wouldn't work—but Norton Utilities was running. I had to reinstall all the network software. I also had to tell Control Panel I have a ViewSonic 17GA Monitor and reset my fonts. After each correction, I had to restart the computer, and I sure got sick of watching the Win 95 start-up screen.

Then Norton Utilities found all kinds of problems with my disk. Eventually it got done correcting them. I'm now back where I was 3 hours ago, except that I have Norton Utilities for Win 95 installed.

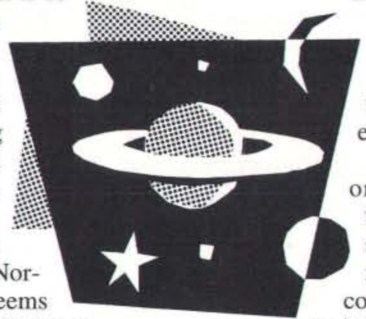
Installed but not running. I'm writing this in Q&A Write. That's a DOS program with a character-based text editor, and it's the editor I use for text creation. There's only one problem. It's jerky. That is, with Norton Utilities running, I can from time to time type most of a word before the first

Circle 316 on Inquiry Card.

letters of the word appear on-screen. If I backspace, it may take a moment before the cursor moves.

It took about 3 minutes of that before I turned off Norton Utilities. That seems to have cured the jerkiness.

There are a lot of things I like about Win 95, but none of them is so great that I'll put up with a jerky text editor. I'd rather go back to Zeke under CP/M and an S-100-bus system! I make my living doing creative writing, and I don't need my computer adding distractions.



I suppose all's well that ends well. Win 95 with Norton Utilities turned off seems to be running smoothly. Moreover, the new build has fixed the problem I had with pasting into DOS Q&A under Win 95. The release version seems pretty clean. I do worry that a simple background process can make a DOS character-based editor jerky; what happens when we have a dozen threads running at once?

Win 95 uses a new system called the registry for keeping track of what Win 95–compliant programs do to your system, and its "remove programs" feature works fine. However, Win 95 does not do well at uninstalling older Windows programs. For that, you need Quarterdeck's new CleanSweep.

I've been using a test version, and it's useful, not only for uninstalling old stuff, but also for finding duplicate files. It's also safe, which is important. When you delete files, CleanSweep bundles them into a package, compresses them, and archives them where it can find them again.

For example, CleanSweep tries to find DLLs that are never called by any program. It then offers you a chance to delete them. In my case, the test version got rid of a few system DLLs that Win 95 needs. There was no harm done. CleanSweep keeps a log of everything it has done and will restore all or any of the archived files. I told it to restore my DLLs, and everything works again.

They're still working on CleanSweep, and they're implementing several suggestions I made. More when it comes out, but this looks to be, like Norton Utilities, one of the must-have Win 95 supplementary programs.

I previously recommended Internet in a Box. It has now ceased working, giving me the message "A2S4LWP.DLL The library is too old to use with this application." I don't know if the program has somehow expired or if it can't handle Win 95 upgrades. Attempts to contact Spry's technical support for the last three weeks via E-mail have been frustrating and useless. You have been warned.

The CD-ROM of the month is Voyage to the Outer Planets from NRSpace. NASA/JPL have accumulated a lot of data, but the formats make it hard to look at their pictures. NRSpace provides a viewer. You get two CD-ROMs of data and pictures of the planets, 2000 photos, and half an hour of video.

Grolier has come out with The 1995 Guinness Multimedia Disc of Records. It's more fun than just looking things up in the book. Want to see a picture of a woman with hair 14 feet long?

I mostly played old games this month. One thing I had fun with was Interactive Image Technologies' Electronic Workbench 4; this is an update of a program I've reviewed previously. When I was a kid, my dream was to have a box full of electronics components and a bucket of solder. This gives you the same thing, except that if you let the blue smoke out of a component, you can fix it on-screen. Build and test electronic circuits of amazing complexity. I wish I'd had this in high school, or college, or when I was at Boeing, for that matter.

The book of the month is Peter Magid and Ira Schneider's *OS/2 Warp Uncensored* (IDG Books, 1995). The title is meaningless, but the book is very complete. If you use or contemplate using OS/2, you'll find this valuable.

Now I'm off to Korea to be keynote speaker at a conference on the unity of the sciences, while Mrs. Pournelle gives a paper on the future of education. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on the Internet or BIX at jerryp@bix.com.

Product Information

CD-Cabin with Link'N'Logging ($99.95) is at least as good as anything else I've seen, and I expect to use it. Contact The Aldridge Co., Houston, TX, (800) 548-5019 or (713) 953-1940; 75462,2340@compuserve.com. **Circle 1246 on Inquiry Card.**

Even if all you want is eye candy, the **Corel Stock Photo Library 2** ($995) is wonderful. Contact Corel Corp., Ottawa, Ontario, Canada, (800) 772-6735 or (613) 728-3733; http://www.corel.com. **Circle 1247.**

The **Definitive Wargame Collection** (estimated street price, $34) is excellent, and any two of the games are worth the price of the whole thing. Contact Strategic Simulations, Inc., Sunnyvale, CA, (800) 245-4525 or (408) 737-6800. **Circle 1248.**

The **DeskPorte Fast 28.8 Modem** ($519) works pretty well. Contact Microcom, Inc., Norwood, MA, (800) 822-8224 or (617) 551-1000; http://www.microcom.com. **Circle 1249.**

Electronics Workbench 4 ($299) lets you build and test electronic circuits of amazing complexity. Contact Interactive Image Technologies, Ltd., North Tonawanda, NY, (800) 263-5552 or (416) 977-5550; http://www.interactiv.com. **Circle 1250.**

The **LabelWriter SE200 Plus** ($499) is one of those gadgets that not everyone needs, but if you need it, you need it bad. Contact CoStar Corp., Greenwich, CT, (800) 426-7827 or (203) 661-9700. **Circle 1251.**

If you like great graphics with lots of action sequences and sound, the **LucasArts Archives Vol. I** (estimated street price, $29.95) is a pretty good collection. Contact LucasArts Entertainment Co., San Rafael, CA, (800) 782-7927 or (415) 472-3400; http://www.lucasarts.com. **Circle 1252.**

The 1995 Guinness Multimedia Disc of Records ($49.95) is more fun than just looking things up in the book. Contact Grolier Electronic Publishing, Inc., Danbury, CT, (800) 285-4534 or (203) 797-3530; http://www.grolier.com. **Circle 1253.**

The **3-D Model Library CD-ROM** ($19.95) is gorgeous. It's a lesson in just what is the state of the art in image modeling. Contact Viewpoint DataLabs International, Orem, UT, (800) 328-2738 or (801) 229-3000; http://www.viewpoint.com. **Circle 1254.**

The CD-ROM of the Month is **Voyage to the Outer Planets** ($49.95). Contact NRSpace, Seattle, WA, (800) 548-7766 or (206) 783-2707. **Circle 1255.**

WHAT'S NEW Hardware

PREVIEW PROCESSOR UPGRADES

Intel Delivers a Better Pentium OverDrive

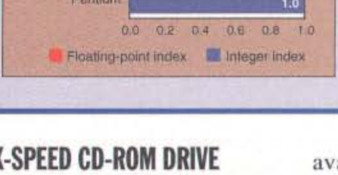
With a street price of approximately $400, Intel's first Pentium OverDrive chip, which was released earlier this year, offers a moderately appealing solution for upgrading your PC's processor from a 25-MHz 486 to a 63-MHz Pentium. The chip's design has compromises, however: It uses a 32-bit, 486-style I/O bus instead of a true Pentium 64-bit internal/external data pathway.

The newest OverDrive still has the 32-bit I/O bus, but its lower price and higher performance make it a better bargain. BYTE's cross-platform BYTEmark CPU/FPU benchmark tests (see the figure below) on the new 5-V, 83-MHz Pentium OverDrive show that this upgrade chip will boost an Intel 66-MHz 486DX2 PC (or any other PC with a 33-MHz I/O bus and a #3 socket) up to performance levels that are slightly less than that of a 90-MHz Pentium. Intel expects the 83-MHz Pentium OverDrive to sell for about $270. (Intel is also lowering the price of the 63-MHz chip to under $300.)

DENNIS WARNESKY © 1995

Intel Corp.
Santa Clara, CA
(800) 538-3373 or call your local Intel dealer
http://www.intel.com/procs/ovrdrive
Circle 976 on Inquiry Card.

Installing the chip is easy if your PC has a ZIF slot, such as the one in the Gateway 2000 486DX2/66 that we tested. You simply raise the latch, pull out the 486 chip, and plop in the OverDrive chip. As with the previous OverDrive, the 83-MHz version comes with a fan attached to the top of the chip (see the photo), as well as a program that monitors the fan. If the fan slows down or stops, the program generates an error message and the CPU throttles back its clock speed.


83-MHz Pentium OverDrive Performance

The 83-MHz Pentium OverDrive chip is an inexpensive and effective upgrade if you want to squeeze more power out of your PC instead of taking the plunge of purchasing a new system.

—Dave Andrews

SIX-SPEED CD-ROM DRIVE

The SCSI Express CD6X (internal, $695; external, $875) offers a 900-KBps data transfer rate, an access speed of 145-ms random access, 115-ms random seek, and a 256-KB buffer. A variety of hardware configurations are available, ranging from single internal drives to one to four external drives in interlocking enclosures, seven-drive towers, and 28- and 49-drive cabinets with MDI's CD-ROM Extenders. Extenders are a bundled option allowing as many as 49 CD-ROM drives on a single host adapter in NetWare environments.

Contact: Micro Design International, Winter Park, FL, (800) 228-0891 or (407) 677-8333; info@microdes.com.

Circle 993 on Inquiry Card.

ACCESS NETWARE LANS VIA ISDN LINES

The PacketBlaster/ISDN PRI ($9995) lets you connect remote sites over switched on-demand ISDN networks or a router-based backbone using ISDN. You can integrate up to 23 B channels in North America or 30 B channels in Europe, with simultaneous server-to-server and remote client–to–server dial-in access. The PacketBlaster/ISDN BRI ($5495; branch-level version, $3995) incorporates a four-port ISA-bus card that supports up to eight concurrent LAN or remote-user B-channel connections. The PacketBlaster ISDN cards provide MPR routing features such as IPX, TCP/IP, and AppleTalk routing; NLSP and Open Shortest Path First (OSPF) link-state routing; packet, service, route, and protocol filtering; data and header compression; synchronous and asynchronous PPP; and remote installation and configuration management.

Contact: Eicon Technology, Dallas, TX, (800) 803-4266 or (214) 239-3270; http://www.eicon.com.

Circle 981 on Inquiry Card.

PENTIUM MOTHERBOARD WITH PCI FAST AND WIDE SCSI

Available in three models—the P54TS (fast SCSI) ($495), P54TSW (wide SCSI) ($565), and P54TSW2 (ultra-wide SCSI) ($635)—the P54TS Pentium PCI motherboard features 128 MB of memory; 75- to 200-MHz processor speeds; five ISA and three PCI expansion slots; and 256 to 512 KB of cache. The P54TS supports EDO/burst EDO DRAM, COAST (for "cache on a stick"), pipelined burst synchronous cache SRAM, two high-speed 16550 UARTs, PS/2 mice, two IDE channels with Bus Master/DMA, and EPP and ECP IEEE 1284 printers.

Contact: Quick Technology, Tustin, CA, (800) 950-8999 or (714) 258-4500.

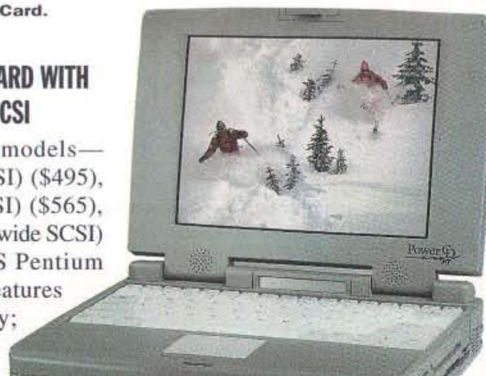
Circle 986 on Inquiry Card.

PENTIUM NOTEBOOK WITH CD-ROM ▼

Based on Intel's 75-, 90-, or 100-MHz Pentium CPU, the 7.1-pound PowerCD features an 800- by 600-pixel or 640- by 480-pixel 9½-, 10.4-, or 11.3-inch dual-scan color or active-matrix color display; a CD-ROM drive; a 3½-inch floppy drive; a center-based TouchPad; a PCI local bus; a microphone and stereo speakers; and a PC Card Type III slot. The PowerCD's ($3550 to $5900) options include an MPEG playback module, a video-capture module, and an internal 14.4/14.4 fax modem. You can upgrade the 8 MB of RAM to 16 or 40 MB, the double-speed CD-ROM drive to triple- or quad-speed, and the 340-MB hard drive to 1 GB.

Contact: Associates Mega Sub-System, Irwindale, CA, (818) 814-8851.

Circle 988 on Inquiry Card.



ALPHA WORKSTATIONS

Powered by a 266- or 300-MHz Alpha 21164 RISC microprocessor, the AlphaStation 600 Models 5/266 and 5/300 can process more than 1 billion instructions per second. The Model 5/266 includes 32 MB of ECC RAM; 2 MB of cache; a 1-GB hard drive; a quad-speed CD-ROM drive; a 3½-inch floppy drive; a 17-inch color monitor; ZLXp-E1 graphics; an audio card; a headset; a microphone; a keyboard mouse; and Windows NT, Digital Unix, or OpenVMS ($29,300 to $31,800). The AlphaStation Model 600 5/300 ($44,995) adds 64 MB of ECC RAM, 4 MB of cache, and a 21-inch monitor to the Model 5/266's configuration. Multimedia enhancements include programming interfaces, video-capture boards, speech-recognition software, and collaborative computing software.

Contact: Digital Equipment, Maynard, MA, (800) 344-4825; http://www.digital.com/info/alphastation.

Circle 977 on Inquiry Card.

ADD SEVEN 32-BIT PCI SLOTS

With the Model 2102 PCI Expansion Unit ($995), you can transparently add seven 32-bit PCI slots to a host computer. The unit supports throughput to 132 MBps and zero-wait-state burst operations. The mini-tower-style cabinet contains an eight-slot PCI motherboard, a PCI backplane controller card that plugs into one of the eight backplane slots, expansion bays for three 3½-inch and two 5¼-inch peripherals, a 250-W power supply, and a 115-/230-V input line-voltage switch.

Contact: Bit 3 Computer, Minneapolis, MN, (612) 881-6955; info@bit3.com.

Circle 979 on Inquiry Card.

ALPHA-BASED WORKSTATION

Based on Digital Equipment's 21064A Alpha processor, a fully configured Telluride Power Workstation ($9994 to $14,607) includes a 200- or 275-MHz Alpha 21064A CPU; 2 MB of secondary cache, upgradable to 8 MB; a double-speed CD-ROM drive; a 1-GB fast SCSI-2 hard drive; a PCI fast SCSI-2 drive controller; 32 MB of DRAM, upgradable to 1 GB; a 4-MB PCI video adapter; 1 MB of flash ROM; a 17-inch, 85-kHz monitor; a high-speed Ethernet PCI combo adapter; a 3½-inch 1.44-MB floppy drive; a full-size tower case; a Keytronics AT keyboard; and a Microsoft PS/2 mouse. The workstation comes with six dedicated PCI slots (three full-length), one dedicated ISA slot, and one PCI/ISA shared slot. Two high-speed serial connectors and one high-speed bidirectional parallel port are included, along with a dedicated serial port for remote diagnostics and maintenance. The Telluride Power Workstation supports Windows NT Workstation, Windows NT Server, Digital Unix, and Digital OpenVMS and is also available as a fully redundant, hot-swappable RAID 5 client/server.

Contact: Aspen Systems, Wheat Ridge, CO, (303) 431-4606; http://www.aspsys.com.

Circle 1000 on Inquiry Card.

30-BIT SINGLE-PASS FLATBED SCANNER

The high-performance 30-bit Z1-600 scanner can distinguish more than 1 billion colors and 1024 shades of gray and, with a maximum of 2400 dpi (300- by 600-dpi optical resolution), hold fine line tolerances and provide razor-sharp details for clearer images. The scanner features an 8½- by 11-inch scanning size combined with dark correction, dark point, white point, histogram display, and automatic threshold control. Also, the Z1-600 ($699) is available with an optional transparency adapter for slides, transparencies, and negatives, plus an optional automatic document feeder.

Contact: Tamarack Technologies, Orange, CA, (714) 744-3979.

Circle 994 on Inquiry Card.

TWO-LINE VOICE/DATA/FAX/AUDIO SYSTEM

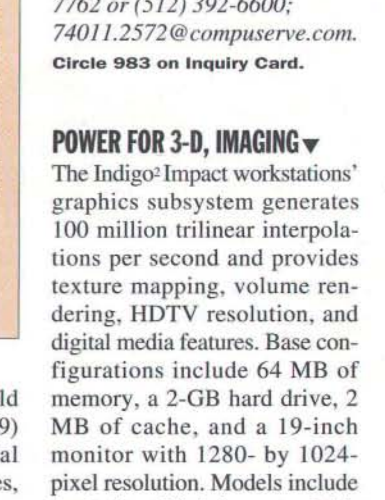
A two-line voice/data/fax and 16-bit audio system, the VoicePro+2 ($329) includes a 14.4-Kbps fax/data modem, dual-line voice-mail, fax-message forwarding, autopaging, a speakerphone, an external fax switcher, music on hold from internal or external audio sources, and caller ID with four message formats. VoicePro+2 also provides local voice recording and playback for both lines; voice/fax message remote retrieval and delivery; 1000 user-defined voice/fax mailboxes; fax-on-demand/fax back on both lines; and page/hold/park/transfer calls. The fax/data modem includes V.32bis and V.17 with CCITT V.29, V.27ter, and V.21 ch2; automatic voice/data/fax recognition; V.42 and MNP 2 through 4 error correction; data compression in V.42bis and MNP 5; and Group 3 fax support.

Contact: Teledapter Systems, San Marcos, TX, (800) 997-7762 or (512) 392-6600; 74011.2572@compuserve.com.

Circle 983 on Inquiry Card.

POWER FOR 3-D, IMAGING ▼

The Indigo^2 Impact workstations' graphics subsystem generates 100 million trilinear interpolations per second and provides texture mapping, volume rendering, HDTV resolution, and digital media features. Base configurations include 64 MB of memory, a 2-GB hard drive, 2 MB of cache, and a 19-inch monitor with 1280- by 1024-pixel resolution. Models include the Indigo^2 High Impact, which is available with a 200- or 250-MHz Mips R4400 microprocessor ($35,000 and $40,000, respectively); the Indigo^2 Maximum Impact, which has a 250-MHz Mips R4400 microprocessor ($51,000); and the Power Indigo^2 Maximum Impact, which has a 75-MHz R8000 microprocessor ($60,000).



Contact: Silicon Graphics, Mountain View, CA, (800) 800-7441 or (415) 960-1980; http://www.sgi.com/Products/Indigo2/IMPACT.

Circle 982 on Inquiry Card.

WHAT'S NEW Hardware

MULTIMEDIA PENTIUM NOTEBOOK ▲

The 6½-pound SENS800 ($2799 to $3799) comes with an Intel 75-MHz P54LM CPU (upgradable to 90 MHz); 8 MB of RAM (expandable to 40 MB via 8-, 16-, or 32-MB memory cards); a 10.4-inch DSTN or TFT color screen with a resolution of 640 by 480 pixels; a microphone and speakers; a 340-MB to 1-GB removable hard drive; a 3½-inch floppy drive; one PC Card Type II slot; one PC Card Type III slot; an 84-key AT-compatible keyboard; an Internal Tracking Ball; 1 MB of video memory; 16-bit stereo sound; local-bus video; and Microsoft Windows Sound System compatibility. Samsung's Power Management System provides up to 4 hours of mobile-computing time and includes such functions as hibernation mode, Smart sleep, suspend/resume, battery-charge control, and a low-battery alarm. Options include a multimedia docking station with a built-in CD-ROM drive ($599).

Contact: Samsung Electronics America, Ridgefield Park, NJ, (800) 316-9914 or (201) 229-4000.

Circle 987 on Inquiry Card.

QUAD-SPEED MULTIMEDIA KIT

The MPC3-compliant Diamond Power Kit 7000 ($399) combines a 16-bit Wavetable Diamond sound card, a quad-speed CD-ROM drive, speakers, an ergonomic joystick, a microphone, and 22 entertainment and reference titles. The sound card uses advanced data-compression technology to fit 2 MB of prerecorded audio samples into 1 MB of memory. The Photo CD– and Multisession XA–compatible CD-ROM drive transfers data at 600 KBps with an access time of 240 ms and a buffer size of 128 KB. The amplified 15-W-per-channel speakers offer separate volume, bass, and treble controls.

Contact: Diamond Multimedia Systems, San Jose, CA, (800) 468-5846 or (408) 325-7000; http://www.diamondmm.com.

Circle 984 on Inquiry Card.

UPGRADE YOUR SPARCSTATION

You can increase the performance of your SparcStation 10, SparcStation 20, and SparcServer 630/670/690 machines to 90- or 125-MHz performance. Available in single-, dual-, and quad-processor configurations, the HyperSparc CPU upgrades (90-MHz, from $3918; 125-MHz, from $6758) offer high-performance symmetric multiprocessing on a standard MBus CPU module. The company also offers a 110-MHz processor (from $10,272) with 1 MB of onboard cache.

Contact: Ross Technology, Austin, TX, (800) 774-7677 or (512) 892-7802; http://www.ross.com.

Circle 980 on Inquiry Card.

FULL-SCREEN VIDEO PLAYBACK

A 64-bit DRAM card, the Paradise Pipeline 64 (from $169) accelerates 8-, 16-, and 24-bit color depths at resolutions of up to 1600 by 1200 pixels. Available for the PCI and VL-Bus with up to a 4-MB DRAM frame buffer, the card features Western Digital's RocketChip WD9710 graphics and motion-video accelerator. This accelerator combines a high-performance RAMDAC, a programmable clock, a VGA core, a graphics engine, and a motion-video engine with built-in logic for YUV-to-RGB color-space conversion, horizontal and vertical scaling and interpolation, and shared frame-buffer control.

Contact: Western Digital, Irvine, CA, (714) 932-5000; http://www.wdc.com.

Circle 989 on Inquiry Card.

V.34 MODEMS▲

Four V.34 fax modems, which are available in external and internal configurations, offer ITU-TSS V.34, for connect speeds up to 28.8 Kbps, and V.42bis and MNP 5 data compression, to allow throughout up to 115.2 Kbps. Performance and accuracy are provided through V.42 (MNP 2 through 4; LAP-M) and MNP 10 error correction. The Fax and Fax II lines support V.34, V.FC, V.32bis, V.32, V.22bis, V.22, V.21, and Bell 212A and 103 standards, as well as the fax standards of V.17, V.29, V.27ter, and V.21. Models include the EC288Fax external modem ($449), PCM288Fax internal modem ($399), EC288Fax II external modem ($549), and the PCM288Fax II internal modem ($499). The Fax II modems offer a system security feature, which restricts the unauthorized access of confidential data or the uploading of damaging files, and Ven-Tel's proprietary Remote Options Access and Downloading, which enables access and reconfiguration of the Fax II modems from any location.

Contact: Ven-Tel, San Jose, CA, (800) 538-5121 or (408) 436-7400.

Circle 995 on Inquiry Card.

TWO-WAY WIRELESS PC CARD MODEM

Designed for use with the ARDIS wireless data communications network, which provides dual 4.8-/19.2-Kbps operation, the Personal Messenger 100D (about $700 to $750) PC Card modem for Type II and III slots lets you send and receive E-mail from your office network or the Internet, send faxes, and access corporate databases. Depending on the application, the battery-powered modem card can continue to receive and store messages even when it's not connected to your portable computer.

Contact: Motorola Wireless Data Group, Schaumburg, IL, (800) 894-7353; http://www.mot.com/wdg/.

Circle 978 on Inquiry Card.

BYTE WEARHOUSE

BYTE 20 Years 1975-1995

Celebrate BYTE's 20th Anniversary with Special Limited Edition Merchandise

All products are officially approved by BYTE.

BASEBALL CAP
Soft brushed cotton free-form cap with adjustable Velcro closure back. Black. (BYT 11) **$10.00**

MUG
11oz. ceramic mug with logo on both sides. (BYT 8) **$4.50**

MOCK TURTLENECK
Outer Banks 100% cotton mock turtleneck. White. Sizes M(BYT 4), L(BYT 5), XL(BYT 6). **$26.00**

INSIGNIA PEN
Parker Insignia ball point pen. Lacquer black. (BYT 9) **$34.50**

SWEATSHIRT
11 oz. cross grain Lee sweatshirt features generous athletic cut and side gussets. 95% cotton, 5% polyester. Ash. Sizes M(BYT 1), L(BYT 2), XL(BYT 3). **$31.00**

COMPUTER TOOL KIT
Deluxe computer device tool kit in black vinyl zipper case features: 2 nut drivers, 3-prong parts retriever, torx driver, IC extractor, 1 phillips and two slotted screwdrivers. (BYT 12) **$20.00**

MOUSE PAD
Hard top mouse pad. 7.5"x 8.5". (BYT 7) **$5.25**

VECTOR PEN
Parker Vector Sport roller ball pen. Black. (BYT 10) **$6.25**

T-SHIRT
100% cotton Oneita Power-T. White. Sizes L(BYT 13), XL(BYT 14). **$8.00**

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We accept VISA, MasterCard, American Express, and Discover.

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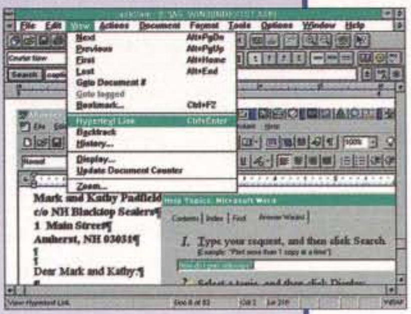
WHAT'S NEW Software

PREVIEW FREE-FORM TEXT DATABASES

askSam Gets Faster and Fuzzier

Version 3.0 of askSam for Windows adds numerous features that should appeal to those who publish electronic directories, policy manuals, instruction books, and other text-based products. Highlights of version 3.0, which is primarily a 16-bit Windows application but also runs under 32-bit Windows, include faster searching, support for fuzzy searching, and the ability to import graphics images in a variety of formats (see the screen). For downloading documents from the Internet, askSam 3.0 lets you import, create, and export documents in the HTML format used on the World Wide Web.



Mark and Kathy Padfield¶
c/o NH Blacktop Sealers¶
1 Main Street¶
Amherst, NH 03031¶
¶
¶
Dear Mark and Kathy:¶

1. Type your request, and then click Search.

askSam 3.0 for Windows
Standard version (without full-text indexing), $149; Professional version (with indexing), $295; version with freely distributable run-time readers, $1495.

askSam Systems
Perry, FL
(800) 800-1997
(904) 584-6590
http://www.asksam.com/asksam.htm
Circle 1001 on Inquiry Card.

Version 3.0's support for full-text indexing greatly improves its search capabilities in databases of several hundred megabytes: Searching a 500-MB indexed file, for example, now takes about a second. Also, support for fuzzy searching lets you locate information when you're unsure of the spelling. For example, I used a fuzzy search to find several documents in an electronic archive of BYTE articles with only the approximate spelling of the author's last name.

askSam lets you define data-entry forms, so end users can rapidly summarize documents they add to a database. To simplify the entry of data into a document database, askSam 3.0 supports pick lists. For example, when you're filling in an author-name field, you can pick a name from a pick list instead of typing it in.

Once you've created an electronic book, you can generate a variety of reports (e.g., all documents created by a specific author). Because askSam is not a relational database, you can't directly generate a report that summarizes information from several electronic books (e.g., all documents created by an author in both the accounting manual and the ethics manual).

But with the program's ability to generate hypertext links across files, you can create an electronic table of contents for navigating through numerous document databases. The full-text indexing should make askSam 3.0 for Windows a stronger product for corporations wishing to create 100-MB or larger electronic books.

—Dave Andrews

BUILD A DATABASE IN YOUR OWN LANGUAGE

With Salsa software ($149; with starter kit, $189), you describe the things you want to track using simple drag-and-drop templates, menus, and buttons, and the program does the rest. You can use your own words, or words specific to your business, to identify a semantic object and each of its characteristics. The software automatically prompts you when it needs more information and provides simple screens for you to input it. With one keystroke, Salsa automatically produces database tables, menus, forms, and reports, and it packages them in an application with its own icon on the Windows desktop.

Contact: Wall Data, Seattle, WA, (800) 987-2572 or (206) 442-9257.

Circle 1004 on Inquiry Card.

MANAGE ROUTERS, BRIDGES, AND SWITCHES ON WANS ▼

An SNMP-based application, RouterManager/AutoBahn (from $1995) provides network management capabilities for multivendor, multiprotocol WANs. The program automates the network-monitoring and data-collection process by monitoring critical network information on an ongoing basis, as well as in the background. With RouterManager/AutoBahn, you can manage your WANs from Windows or any major Windows- or NT-based platforms.

The ConfigurationManager manages router configurations from a central location on a domain or global basis; AlarmManager continuously monitors the status of each router and generates an alarm whenever any errors are found or when user-defined thresholds are crossed. SecurityControl allows the administrator to limit access to RouterManager/AutoBahn features to select individuals or groups; PathFinder pinpoints the problem areas when connectivity is lost between sites or when links are congested; and FlashManager supplies a directory of all the software images that are stored on the routers.

Contact: StonyBrook Software, Bohemia, NY, (516) 567-6060; sales@sbrook.mhs.compuserve.com.

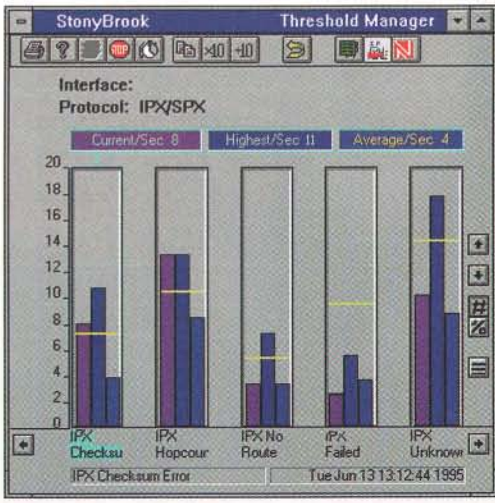
Circle 1012 on Inquiry Card.

CIRCUIT SIMULATION INSIDE MICROSOFT EXCEL

Spectre/XL embeds circuit simulation inside Microsoft Excel, so you can evaluate, develop, and optimize circuit designs. As with other Excel functions, you can combine Spectre/XL functions in formulas, use them in design calculations, organize them into tables, or chart them. From within Excel, you embed a circuit object with a SPICE-like description onto a worksheet. You then set up links between the worksheet cells and component values in the circuit. Changing the cell value—by hand, by formula, or by programming—automatically changes the circuit value. Spectre/XL ($695) returns DC, AC, or nonlinear frequency responses and lets you use Excel's built-in Goal Seek and Solver optimizing functions to improve designs.

Contact: Avista Design Systems, Folsom, CA, (800) 985-6080 or (916) 985-6080; http://www.avista.com/avista.

Circle 1011 on Inquiry Card.



Interface:
Protocol: IPX/SPX

IPX Checksum Error
Tue Jun 13 13:12:44 1995

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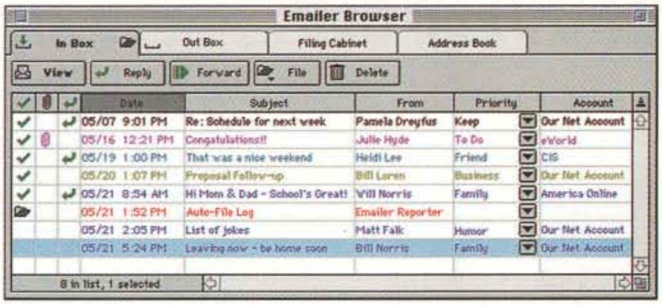
Whether you subscribe to an Internet service or to America Online, CompuServe, eWorld, or RadioMail, Claris Emailer lets you send, receive, reply, forward, and store E-mail messages and files. An address book of E-mail addresses can store multiple E-mail addresses for individuals, as well as group addresses, so you can send the same message to multiple recipients with a single command. The text editor lets you easily create outgoing messages and attach files from your hard disk or network. Claris Emailer ($89) supports file-compression formats such as RinHex, uuencode, Base 64, and MIME.

Contact: Claris, Santa Clara, CA, (800) 544-8554 or (408) 987-7000; http://www.claris.com.

Circle 1007 on Inquiry Card.



✓			Date	Subject	From	Priority	Account
✓		↩	05/07 9:01 PM	Re: Schedule for next week	Pamela Dreyfus	Keep	Our Net Account
✓			05/16 12:21 PM	Congatulations!!	Julie Hyde	To Do	eWorld
✓		↩	05/19 1:00 PM	That was a nice weekend	Heidi Lee	Friend	CIS
✓			05/20 1:07 PM	Proposal Follow-up	Bill Loren	Business	Our Net Account
✓		↩	05/21 8:54 AM	Hi Mom & Dad - School's Great!	Will Norris	Family	America Online
			05/21 1:52 PM	Auto-File Log	Emailer Reporter		
			05/21 2:05 PM	List of jokes	Matt Falk	Humor	Our Net Account
			05/21 5:24 PM	Leaving now - be home soon	Bill Norris	Family	Our Net Account

8 in list, 1 selected

OS/2 AND UNIX DICTIONARY

The American Heritage Dictionary and Roget's II Thesaurus Deluxe Edition for OS/2 and Unix ($59.95) is a package that provides an up-to-date dictionary with full definitions, parts of speech, pronunciations, abbreviations, and sample sentences for more than 200,000 words. In addition, the electronic thesaurus has more than 500,000 synonyms, word senses, and meanings. The product works within applications such as word processors, spreadsheets, databases, and even E-mail. Available in single and multiuser LAN versions, the package is also available in international versions.

Contact: Dux Software, Palo Alto, CA, (800) 543-4999 or (415) 473-1800; http://www.rivendell.com/dux.

Circle 1013 on Inquiry Card.

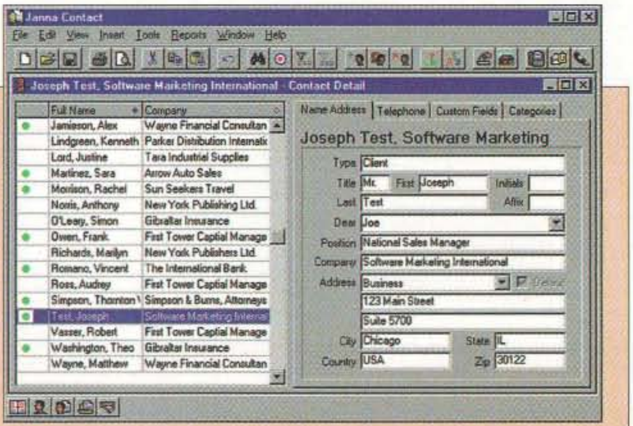
PCB LAYOUT FOR WINDOWS 3.1

WinBoard 2.0 ($995; with WinDraft schematics, $1495) includes placement tools for x,y placement and Place File; enhanced editing, including the ability to edit net characteristics; select or exclude layers for routing and via placement; more than 400 new SMT footprints, including the complete IPC-SM-782 library; and improved memory management. With the Online Graphical Editor, you can create custom modules or edit existing modules on-line. WinBoard's Pad Stack Editor lets you create any number of user-definable pad shapes per layer, and Update Netlist lets you forward annotations from the schematic. A Module De-Compiler provides library source code, so you can make ASCII edits to the library files; the T-Tracks feature lets you move or drag adjoining track segments.

Contact: Ivex Design International, Beaverton, OR, (503) 531-3555; http://www.ivex.com.

Circle 1006 on Inquiry Card.

MANAGE CONTACTS AND DOCUMENTS IN WINDOWS 95


Janna Contact
File Edit View Insert Tools Reports Window Help
Joseph Test, Software Marketing International - Contact Detail
Name Address
Telephone
Custom Fields
Categories

	Full Name	Company
●	Jamieson, Alex	Wayne Financial Consultan
	Lindgreen, Kenneth	Parker Distribution Internatio
	Lord, Justine	Tara Industrial Supplies
●	Martinez, Sara	Arrow Auto Sales
●	Morrison, Rachel	Sun Seekers Travel
	Norris, Anthony	New York Publishing Ltd.
	O'Leary, Simon	Gibraltar Insurance
●	Owen, Frank	First Tower Captial Manage
	Richards, Marilyn	New York Publishers Ltd.
●	Romano, Vincent	The International Bank
	Ross, Audrey	First Tower Captial Manage
●	Simpson, Thornton \	Simpson & Burns, Attorneys
●	Test, Joseph	Software Marketing Internat
	Vasser, Robert	First Tower Captial Manage
●	Washington, Theo	Gibraltar Insurance
	Wayne, Matthew	Wayne Financial Consultan

Joseph Test, Software Marketing

Type: Client
Title: Mr. First: Joseph Initials:
Last: Test Affix:
Dear: Joe
Position: National Sales Manager
Company: Software Marketing International
Address: Business
123 Main Street
Suite 5700
City: Chicago State: IL
Country: USA Zip: 30122

Janna Contact 95 (US$99) provides contact, document, and time management; communications; and a multimedia database. You can store documents, including letters, faxes, spreadsheets, presentations, and even voice notes and full-motion videos, along with your contacts. Contact management features include name, company, address, phone, and fax numbers; unlimited addresses, custom fields, and categories; and unlimited date-stamped text notes. Communications features let you send personalized letters to contacts, send and receive E-mail with Microsoft Exchange, and send and receive faxes with Microsoft Fax at Work. With OLE 2.0 support and the multimedia database, you can import data into the Microsoft Access 95 database.

Contact: Janna Systems, Toronto, Ontario, Canada, (800) 268-6107 or (416) 483-7711; info@janna.com.

Circle 1002 on Inquiry Card.

Software Update

StorageManager 4.0, backup and storage management for NetWare 3.x and 4.x servers, combines the backup capabilities of Backup Director 4.0, the automated archiving and media management of The Network Archivist, and rules-based Hierarchical Storage Management software. The program prevents, detects, and automatically recovers from system, user, hardware, or media failure. Single-server networks of up to 25 users, $995; single server with unlimited user support, $1995; multiserver with unlimited users, $3595.

Contact: Palindrome, Naperville, IL, (800) 288-4912 or (708) 505-3300; http://www.palindrome.com.

Circle 1018 on Inquiry Card.

A desktop organizer, **DragStrip 2.0** includes extensive AppleScript support; new options for icon and button styles, custom fonts, colors, and labeling; options for renaming items and editing pop-up document lists; support for Control Strip modules; the ability to apply labels and colors on a per-strip basis; and Bali, a program that lets you cancel accidental application launches with a single click. $59.95.

Contact: Natural Intelligence, Cambridge, MA, (800) 999-4649 or (617) 876-4876; http://www.natural.com/.

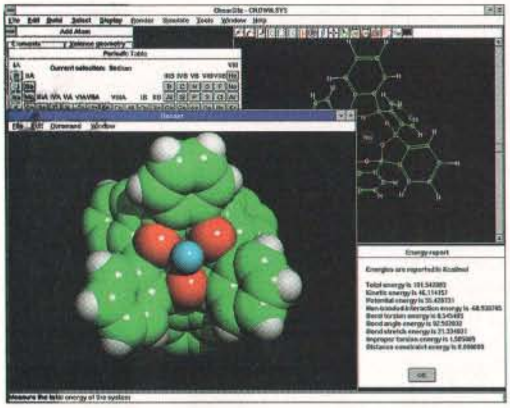
Circle 1022 on Inquiry Card.

NetTools 5.3, Windows desktop-configuration management, incorporates HelpPlus, an ODBC-compliant trouble-ticket generator that helps you identify improperly set or altered desktop-configuration files and supports Adobe PostScript printer drivers. Two-year subscription fee for NetWare and NT Server, $32 per node for 50 nodes to $19.50 per node for 1000 licenses.

Contact: McAfee, Santa Clara, CA, (408) 988-3832; http://www.mcafee.com.

Circle 1020 on Inquiry Card.

WHAT'S NEW Software



MOLECULAR VISUALIZER ▲

ChemSite for Windows ($99) is a molecular visualizer for building, displaying, and simulating the dynamic behavior of chemical structures, which you can then incorporate into presentations, lectures, and laboratory studies. Built-in rules of chemistry prevent you from creating structures that are chemically impossible, or you can simply deactivate them to construct any configuration of atoms. ChemSite also reads and writes data files from other molecular-modeling and chemical-drawing programs, allows you to transport structures directly into programs that support the Windows Clipboard or BMP files, and renders collections of spheres, balls and sticks, Bézier curves, and molecular orbitals.

Contact: Pyramid Learning, San Jose, CA, (800) 610-2436 or (415) 323-4907; pyramid@netcom.com.

Circle 1010 on Inquiry Card.

DATA RECOVERY FOR DOS AND WINDOWS

Rescue ($99) can recover data from crashed floppy disks and hard drives, even those with corrupted or deleted primary partitions, in as little as 60 seconds, according to AllMicro. The program automatically recovers virtually any DOS or Windows file, including EXE, application, compressed, deleted, binary, and graphics files; works on compressed drives and deleted files; includes antivirus features that detect and eliminate more than 5000 viruses and immunize your files from further infections; and automatically backs up your files.

Contact: AllMicro, Clearwater, FL, (800) 653-4933 or (813) 539-7283; allmicro@ix.netcom.com.

Circle 1008 on Inquiry Card.

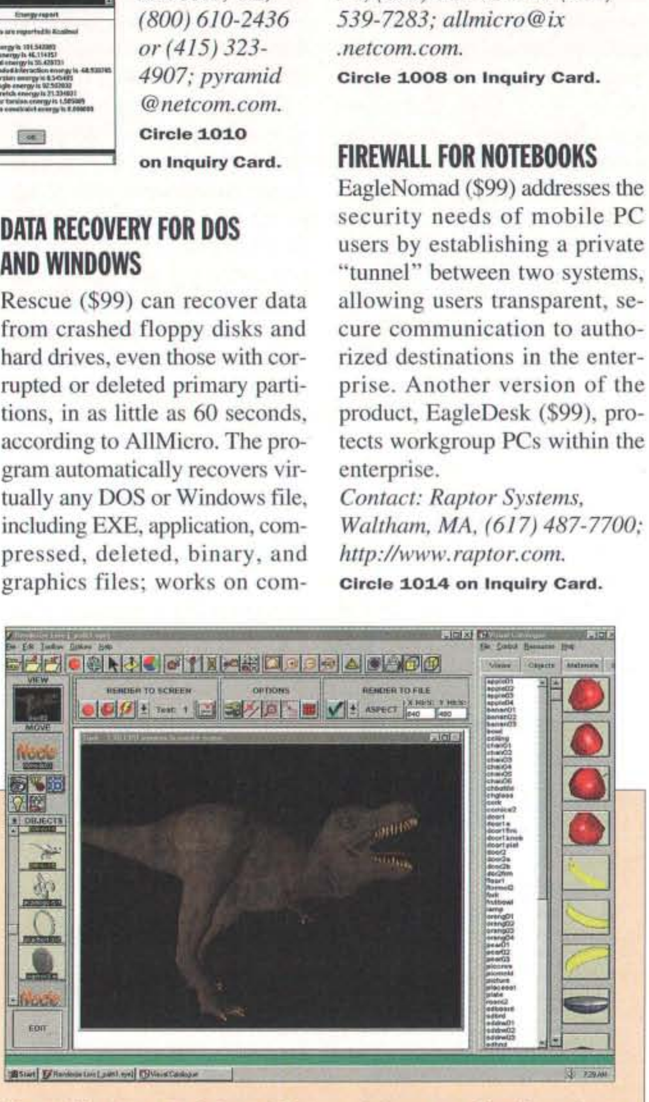
FIREWALL FOR NOTEBOOKS

EagleNomad ($99) addresses the security needs of mobile PC users by establishing a private "tunnel" between two systems, allowing users transparent, secure communication to authorized destinations in the enterprise. Another version of the product, EagleDesk ($99), protects workgroup PCs within the enterprise.

Contact: Raptor Systems, Waltham, MA, (617) 487-7700; http://www.raptor.com.

Circle 1014 on Inquiry Card.

3-D GRAPHICS AND ANIMATION



Now artists, designers, and multimedia developers can work in 3-D with Visual Reality 2.0 for Windows ($259). The package, which consists of four modules—RenderizeLive, Visual Model, Visual Font, and Visual Image—lets you drag and drop objects, materials, and images between applications. RenderizeLive, a 3-D rendering and animation tool, lets you combine input from other Visual Reality 2.0 modules and images to create full-color, high-resolution, photo-realistic renderings. Visual Model lets you create 3-D models, Visual Font transforms TrueType fonts into 3-D words, and Visual Image lets you combine or collage photos and images and then perform multilayer image-processing and enhancement procedures. Visual Reality 2.0 also includes push/pull, melt, stretch, twist, and band tools; enhanced free-form modeling; key-frame object and camera animation; the ability to drag and drop 3-D data from Visual Catalog, a 3-D data module; solid-shaded modeling; 3-D Boolean operations; organic deformations; and 3-D morphing between objects.

Contact: Visual Software, Woodland Hills, CA, (800) 669-7318 or (818) 883-7900.

Circle 1003 on Inquiry Card.

Software Update

A query tool for AS/400 data access, **ShowCase Vista 3.1** lets you import Query/400 and SQL/400 objects; manage and control query jobs by assigning which batch subsystem a job can run in, and at what priority; and test queries in a controlled environment before handing them over to end users. Other features include OS/400 V3R1 compatibility and improved data-viewer capabilities. Single-user license, $1500.

Contact: ShowCase, Rochester, MN, (800) 829-3555 or (507) 288-5922; http://www.bismark.com/showcase.

Circle 1021 on Inquiry Card.

Software that lets you run Lotus SmartSuite, Microsoft Office, and other Windows applications on Solaris, **Wabi 2.1** includes multimedia support and ODBC support, which lets you access databases such as Oracle and Sybase from your Windows productivity databases. An X Window System client application, Wabi can run in a client/server configuration, residing on one system (a server) and displaying on others (clients). Wabi 2.1 is available in French, Japanese, Italian, German, Spanish, and Swedish versions. $225.

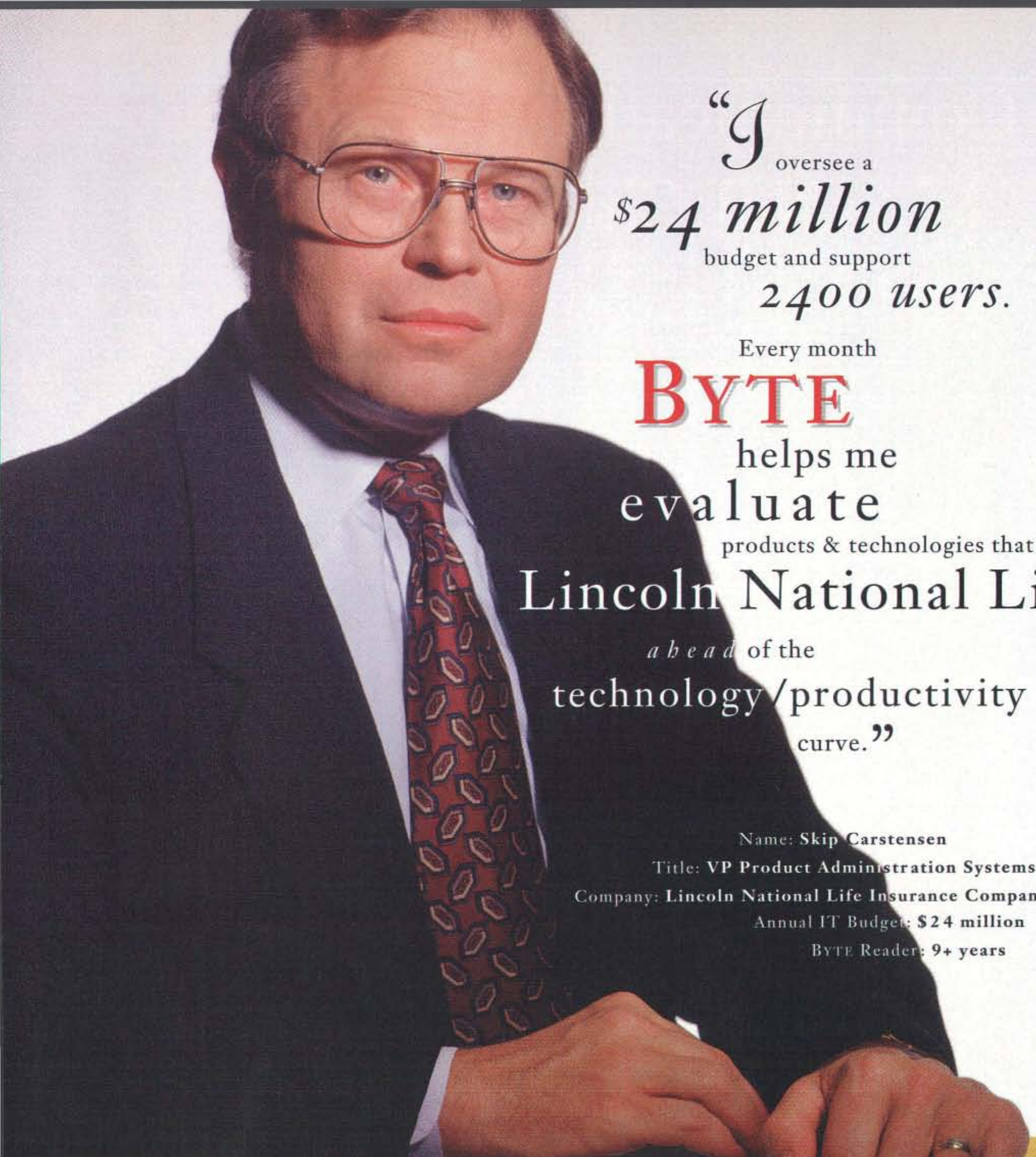
Contact: SunSoft, Mountain View, CA, (800) 786-7638 or (512) 434-1511; http://www.-sun.com/sunsoft/Products/PC-Integration-products.

Circle 1019 on Inquiry Card.

A Unix-based, multifunctional, network-ready package, **OnContact Enterprise 3.53** adds enhanced security, new scheduling methods, setup features, fax integration, upgraded merging capabilities, and advanced printing functionality. $1095 per user.

Contact: Software Development Group, Cedarburg, WI, (800) 886-0866 or (414) 375-6555.

Circle 1023 on Inquiry Card.



"I oversee a
$24 million
budget and support
2400 users.

Every month
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helps me
evaluate
products & technologies that keep
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ahead of the
technology/productivity
curve."

Name: **Skip Carstensen**
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Company: **Lincoln National Life Insurance Company**
Annual IT Budget: **$24 million**
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57 HIGH-POWERED SYSTEMS REVIEWED

BYTE

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Apple's Power Macintosh and IBM's Power Personal Systems

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CPU Wars: Should you move from CISC to RISC?

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COMDEX/Fall '95 November 13–17, 1995 • Las Vegas, Nevada USA

Circle 89 on Inquiry Card (RESELLERS: 90).

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272

Hardware/Software Showcase

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291

Buyer's Mart

The BYTE classified directory of computer products and services, organized by subject so you can easily locate the right product.

301

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External parallel	CALL!	

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***Call for compatibility information.*

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3C1627 12 port Linkbuilder 10BT	621.06

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NodeRunner 2000T	169.05
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intel

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EtherExpress PRO/10 Flsh combo 5pk	472.00
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EtherExpress 16 10B T 5pk	469.50
EtherExpress 16 10BT 20pk	1698.38
EtherExpress MCA 10BT	166.52
EtherExpress 16 combo	116.77
EtherExpress 16 combo 5pk	549.72
EtherExpress EISA, coax	409.88
EtherExpress Flsh combo	129.79
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Etherpower2 combo	271.05
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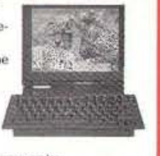

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DATA CARTRIDGES

DESCRIPTION	3M	MAXELL	SONY
DC-2120	8.90	8.20	8.50
DC-6150	9.50	9.30	9.30
DC-6250	12.50	12.30	12.30
DC-6525	16.50	16.30	16.30

STREAMER CASSETTES

MAXELL			TEAC	
CS-600 HD	11.95	60 MB	CT-600H	14.75
CS-600 XD	12.95	150 MB	CT-600N	19.75
CS-600 SX	19.95	600 MB	CT-600F	30.75

4 MM & 8 MM CARTRIDGES

DESCRIPTION	TDK	SONY	EXABYTE
4MM 60 Meter	4.95	5.95	8.25
4MM 90 Meter	5.35	7.35	9.95
8MM 112 Meter	5.25	6.75	8.95

OPTICAL DISKS

DESCRIPTION	MAXELL	3M	SONY
3.5" 512/128 MB	17.95	18.95	14.95
3.5" 512/230 MB	27.95	27.95	25.95
5.25" 600/650 MB	54.95	55.95	52.95
5.25" 1.2/1.3 GB	65.95	66.95	63.95

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HP51626A	20.50	HPC3835A	37.75
HP51629A	21.50	HP92281K	52.75
HP51649A	23.50	HP17703T	35.75

LASER TONERS		RIBBONS	
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HPC3903A	67.95	HP92155A	11.75
HP92291A	106.95	HP92155L	13.95
HP92295A	61.95	HP92156S	8.45
HP92298A	92.95	HP92154B	109.00

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KX-P155 RIBBON	6.99
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KX-P4450 DRUM KIT	115.69

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TONER	6000 +	15.95
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LNO3X-AD OPC KIT	124.00
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5¼" GOLD 20 MB	63.95
5¼" GOLD 44 MB	103.95
5¼" GOLD 90 MB	74.95
5¼" GOLD 150 MB	79.95

SYQUEST (Removable Disk Cart)

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88 MB	56.95
105 MB	56.95
270 MB	55.95

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BC-02	INK CARTRIDGE	18.95
BJI-481	INK CARTRIDGE	11.95
BJI-642	INK CARTRIDGE	14.95
BJI-801	INK CARTRIDGE	8.95
EPS/SX	TONER HP 92295A	55.95
EPL/IIP	TONER HP 92275A	62.95

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016-1124-00	COLOR STIX CYAN	75.00
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016-1128-00	COLOR STIX YELLOW	75.00
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8750	3.05	SO51011	155.95
8755	3.45	SO51023	108.95
8762	5.85	INK JETS	
8763	4.25	SO20002	18.95
8764	9.05	SO20025	9.50
8766	17.75	SO20034	11.75
8767	11.45	SO20036	23.95

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1040282	45.30	1348331	295.00
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1299095	1.80	1380200	143.00
1299790	9.90	1380520	160.00
1299845	3.90	1669113	17.00
1299933	13.80	1669115	60.00
1319308	11.30	1669151	60.00
1337765	2.70	70X7001	72.00
1361195	1.60	70X7002	175.00
1380999	3.40	70X7003	17.00
6295158	28.40	70X7280	34.00
6328829	5.30	70X7281	124.00
6845100	28.90	70X7243	363.00
7034437	27.50	70X7244	276.00
7034640	5.60	70X7285	85.00
7819690	12.80	70X7286	384.00

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650 MB GLASS	512/1024	109.00
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1 GB GLASS	512/1024	139.00
1.2 GB POLY	512/1024	99.00
1.2 GB GLASS	512/1024	139.00

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Jameco 486SLC2 66MHz Bare-bones System

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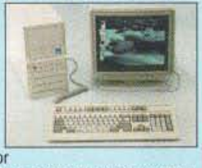

- IBM 486SLC2-66 CPU
- Supports optional 80387SX-33 math-coprocessor
- Memory expandable to 16MB using (70ns) SIMMs
- Seven 16-bit with two 32-bit (VESA local bus) slot extensions and one 8-bit slot
- AMI BIOS

121208	486SLC2 66MHz	$279.95

Jameco Motherboards

79214

- Some motherboards also available without CPU. Call for details
- Diagnostic and operating system software available
- One-year warranty

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117401	80386DX 40MHz w/ CPU	129.95
79214	80486SX 25MHz w/ CPU	179.95
116118	80486SLC 66MHz w/ CPU	219.95
95222	80486DX 33MHz w/ CPU	249.95
95169*	80486DX w/o CPU	139.95
119731	486DX2 66MHz Motherboard	329.95
124652	Pentium 75MHz Motherboard	499.95
124644	Pentium 75/90/100MHz w/o CPU	299.95

*Applicable w/ DX2-66/50 or DX33/40/50

Dynamic RAM

DIPs

Part No.	Product No.	Pins	Description	Price
41620	4164-100	16	64KB x 1 100ns	$1.39
41435	41256-60	16	256KB x 1 60ns	2.39
41443	41256-80	16	256KB x 1 80ns	2.19
41371	41256-100	16	256KB x 1 100ns	1.79
42243	511000P-70	18	1MB x 1 70ns	6.29
42251	511000P-80	18	1MB x 1 80ns	6.19

SIMMs

Part No.	Product No.	Description	Price
53701	94000S-70	4MB x 9 70ns	$169.95
53719	94000S-80	4MB x 9 80ns	164.95
41486	41256A9B-10	256KB x 9 100ns	8.95
41507	41256A9B-60	256KB x 9 60ns	14.49
41515	41256A9B-70	256KB x 9 70ns	14.25
41523	41256A9B-80	256KB x 9 80ns	13.75
41769	421000A9B-80	1MB x 9 80ns	44.95

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- For laptops and standard cases

119087	7120AI	120MB 3.5"	$129.95
119095	ST9145AG	120MB 2.5" for laptops	149.95
123191	H2172-A2	172MB 2.5" for laptops	149.95
115764	CFS420A	426MB 3.5"	189.95
125701	CFS635A	635MB 3.5"	239.95
118949	CFA850A	850MB 3.5"	279.95
124978	CFS1275A	1.27GB 3.5"	399.95
67061	JE1066A	16-bit hard/floppy card	29.95

Floppy Disk Drives

118957

- PC/XT/AT compatible
- P/N 120045 includes mounting kit & faceplate for use in 5.25" floppy disk drive bays

120045	Sony 1.44 MB 3.5"	$44.95
118957	Panasonic 1.2 MB 5.25"	39.95
118922	Panasonic 1.44 MB 3.5"	49.95
119722	Toshiba 1.44 MB 3.5"	44.95
74392	Teac 3.5"/5.25" Combo	129.95

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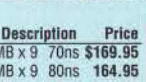
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- Fits most popular desktop, mini vertical and vertical cases
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- One-year warranty
- Built-in fan

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67467	200 Watt (8088/80286)	59.95
19545	200 Watt	69.95
19529	200 Watt mini	49.95
65728	300 Watt	99.95

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20431	84-key keyboard	$19.95
114868	84-key keyboard, AT, use 114850	59.95
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78297	101-key AT compatible keyboard	19.95
67432	101-key PC/XT/AT/386/486 compat.	19.95
119044	101-key w/ trackball, PC/XT/AT; PS2	59.95
119167	101-key foldable, PC/XT/AT; PS2	79.95
17128	101-key enhanced keyboard	69.95
119554	101-key w/ built-in phone headset	109.95
124089	101-key multimedia keyboard	99.95
119669	124-key programmable keyboard	69.95
17136	130-key keyboard with calculator	79.95

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- Installation is easy! Just snap it in

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SPECIAL

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- MTBF: 30,000 hours
- Circulates air directly
- CFM: 25
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79020	TSM Fancard II	$19.95

Jameco PC Air Exhaust Fan

NEW

- Connects to card slot (non electrically)
- The airduct can be extended and fan assembly reversed
- 12VDC 20 CFM airflow
- One-year warranty

124492	PC air exhaust fan	$24.95

28.8 bps Data/Fax Internal Modem

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BLAZING 28.8 bps

- Data throughput up to 115,200 bps (data compression)
- 28,800 bps (Data v.34)
- 14,400 bps group III fax
- V.42 / MNP 2-4 error control
- 16550A UART compatible interface
- Hayes compatible
- FCC class B, part 68 certified
- Weight: 2 lbs.
- One-year warranty

124476	Internal 28800 Fax/modem	$179.95

ACECAD Acecat II

SPECIAL

- For use with PC/XT/AT and compatibles with MS DOS, MS Windows 3.x, Pen DOS or Pen Point
- Includes 2-button, feather-light pen
- MM1201 and Microsoft Mouse emulation
- Compact 5" x 5" active area
- 2000 LPI resolution
- Lift-up template overlay
- Easy Auto-Driver installation utility
- Includes WINTAB, ADI and MS Mouse Drivers
- Can co-exist with a mouse in Windows
- Size: 8"W x 9.5"D x 1"H
- Weight: 1.0 lb.
- One-year warranty

120096	5" x 5" Digitizer tablet	$99.95

3 Button Serial Mouse

- PC/XT/386/486 and compatible computers
- Microsoft® Mouse compatible
- One-year warranty
- Weight: 1 lb.

104441	3 Button serial mouse	$8.95

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- 5.25" half-height internally mounted drive connects to CD-ROM and floppy drive interfaces
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124960	Combo CD-ROM & floppy drive	$279.95

9600 bps Fax Machine

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- Turns your computer printer into an intelligent, plain paper fax machine
- Prints high-quality faxes and transmits/receives high quality, computer-generated documents and graphics
- Maintains a floppy disk copy of all received faxes
- Includes fax forwarding, junk fax screening and scheduled transmission
- Weight: 5.5 lbs.

123131	9600bps fax machine	$49.95

Gamestar Programmable Game Controller

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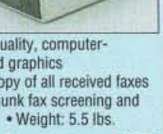
Game Control

Configuration Control

- Works w/ any IBM compatible with MS DOS or PC DOS
- Plugs into keyboard port
- Emulates any keystroke from joystick
- Program and save created game templates
- Variable rapid-fire feature
- Includes configuration and game control
- Size: 6.5"L x 3.3"W
- Weight: 1.1 lbs.
- One-year warranty

124505	Programmable game controller	$19.95

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123060	EZ Drive software	$29.95
123078	DrivePro software	69.95
123051	Technical Library CD-ROM	279.95
123086	Hard Drive Encyclopedia	149.95

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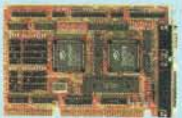
Add four serial and three parallel ports!

SPECIAL

- UART chips emulate 16550 UARTs
- 16-bit card
- PC/XT/AT and compatible computers
- Can be used in an 8-bit system with IRQ 3, 4, 5, 7
- Four serial ports
- Three parallel ports
- All ports configurable to IRQ 3, 4, 5, 7, 9, 10, 11, 12, and 15
- Parallel ports are selectable for normal or bi-directional modes
- Weight: 1 lb.
- One-year warranty

117971	Input/Output card	$79.95

Jameco Input/Output Card



Add four serial and three parallel ports!

- UART chips emulate 16450 UART's
- 16-bit card
- PC/XT/AT and compatible computers
- Can be used in an 8-bit system with IRQ 3, 4, 5, 7
- Serial ports addressable to 3B8, 2F8, 3E8, 2E8
- Parallel ports addressable to 3BC, 378, 278
- All ports configurable to IRQ 3, 4, 5, 7, 9, 10, 11, 12 and 15
- Cables and panel brackets included for all ports
- Weight: 1 lb.
- One-year warranty

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Protect data lines connecting networked equipment. Guard against the effects of lighting, electrostatic discharge, ground surges and faulty wiring which routinely cause glitches, lock-ups, and hardware damage. Lifetime product warranty.

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- Optional 4X CD-ROM Drive (swap floppy & CD-ROM)
- Multimedia docking station with PCI bus
- Built-in 16-bit sound, microphone, **2 speakers** & MIDI
- **HUGE**, 1.26GB hard drives

Processor	Screen	HD	Price
Pentium 120	11.3" Dual Scan	1.26GB	CALL
Pentium 120	11.3" Active	1.26GB	CALL

Satellite 2130

Satellite 2110/2130

- 10.4" Dual Scan & Active
- Built-in AC adapter - small, sleek design & reduced weight
- Integrated Accupoint - small, accurate & easy to use

Processor	Screen	HD	Price
486DX4/75	10.4" Dual Scan	330MB	$1979
486DX4/75	10.4" Dual Scan	500MB	2459
486DX4/75	10.4" Active	500MB	3059

Pentium 75 with Built-in 4X CD-ROM

Satellite Pro T400

Satellite Pro 400

- Built-in 4X CD-ROM Drive(Swap floppy & CD-ROM) (Active model only, optional on Dual Scan)
- Pentium 75MHz Processor
- Built-in 16-bit sound, microphone, speaker & MIDI
- 10.4" Active & Dual Scan
- Built-in AC adapter - small, sleek design & reduced weight
- Integrated Accupoint - small, accurate & easy to use
- Lithium Ion battery technology
- Built-in infrared for no-hassle printer connections

Processor	Screen	HD	Price
Pentium 75MHz	10.4" Dual Scan	772MB	$3539
Pentium 75MHz	10.4" Active	772MB	4359

90MHz Pentium

Portégé 610CT

Portégé 610CT

- Pentium 90MHz processor
- 9.5" True Color display for optimum color
- Built-in 16-bit sound (SoundBlaster Pro compatible), microphone & speaker
- Lithium Ion battery technology
- Accupoint stick for easy control

Processor	Screen	HD	Price
Pentium 90MHz	9.5" True Color	720MB	$4359

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Versa 2000

Versa 2000

- Lithium Ion battery technology
- VersaGlide touch-pad pointer – simple & accurate
- Built-in, upgradable 14.4 fax/modem (on selected models)
- LOADS of **FREE** software preinstalled

Processor	Screen	HD	Price
486DX4/75	10.4" Dual Scan	350MB	$1999*
486DX4/75	9.5" Active	350MB	2299*
486DX4/75	9.5" Active	350MB	2599
486DX4/75	9.5" Active	540MB	2799

*14.4 fax/modem not built-in

Built-In CD-ROM

WIN95 INSTALLED

Versa 4000

NEC Versa 4000

- Built-in CD-ROM Drive! (Standard on some models, optional on others)
- Pentium 75 and Pentium 90 processors
- 256KB Level 2 Cache to optimize performance
- Unbelievable displays – 65K color Dual Scan, 16.8 million color Active (High resolution Active Matrix displays available – 800x600 res.)
- Built-in 16-bit sound, microphone, MIDI and **2 built-in speakers**
- Multimedia docking station with outstanding Altec Lansing 4 speaker array

Processor	Screen	HD	Price
Pentium 75	10.4" Dual Scan	540MB	$3499
Pentium 75	10.4" Dual Scan	540MB	3799*
Pentium 75	10.1" Active	540MB	3999
Pentium 90	10.1" Active	810MB	4649*
Pentium 90	10.4" High Res.	810MB	4799

* Features built-in CD-ROM drive standard

TEXAS INSTRUMENTS

75MHz Pentium with PCI BUS

Extensa 550

Extensa 550/550CD

- 75MHz Pentium w/PCI bus & 256KB cache
- Built-in 2X CD-ROM drive (optional on some models)
- Built-in 16-bit sound, microphone & speaker
- Integrated touchpad pointer
- 10.4" Active Matrix display/10.4" Dual Scan
- Built-in infrared for wireless communications

Processor	Screen	HD	Price
Pentium 75	10.4" Dual Scan	524MB	$2499*
Pentium 75	10.4" Dual Scan	524MB	2939
Pentium 75	10.4" Active	524MB	3519

*CD-ROM Drive is an optional accessory on this model

Extensa 450

- 10.4" Dual Scan & 9.5" Active display
- GlidePad pointing device
- Advanced battery pro
- Built-in infrared for no-hassle printer connections

Processor	Screen	HD	Price
486DX4/75	10.4" Dual Scan	340MB	$1769
486DX4/75	9.5" Active	340MB	2349

TravelMate 5000/5100

- 75MHz or 90MHz Pentium with PCI Bus to optimize Pentium processor performance
- 10.4" Active Matrix display with 2MB Video RAM
- 10.5" Dual Scan display with 2MB Video RAM
- 65K colors on notebook display
- 16-bit Sound Card, Speaker, Microphone & MIDI
- Upgradable hard drive - easily add more storage
- Built-In Dual Lithium Ion batteries
- Built-in infrared for no-hassle printer connections

Processor	Screen	HD	Price
Pentium 75	10.4" Dual Scan	500MB	$3479
Pentium 75	10.4" Active	772MB	4499
Pentium 90	10.4" Active	1.2GB	5299

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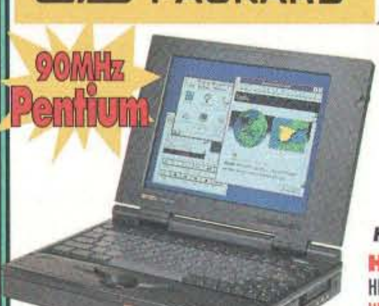

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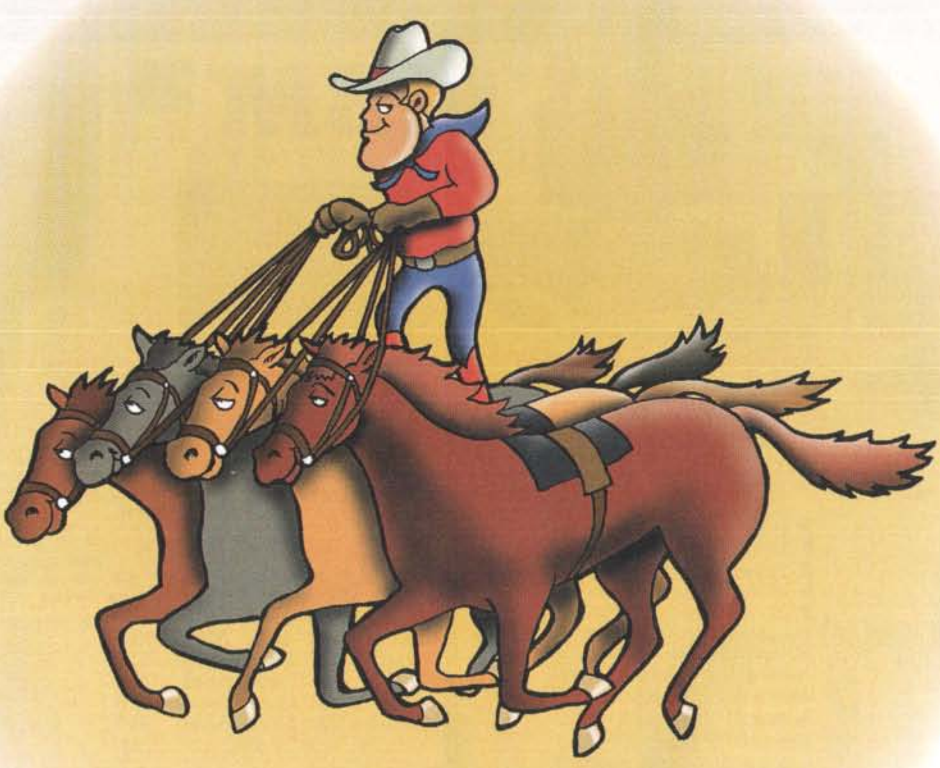

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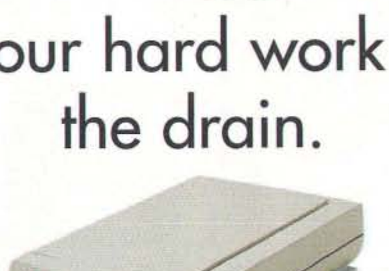

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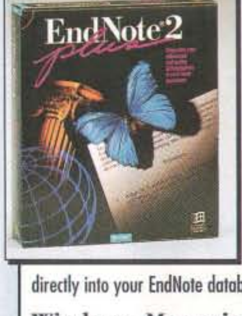

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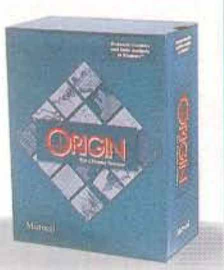

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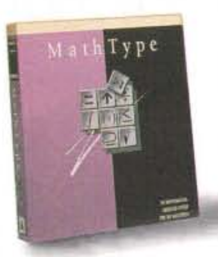

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MC2210A	1.05GB	10MS	IDE	$645-795
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MC4110	1.05GB	9MS	SCSI-2	650-775
MC2217	1.75GB	10MS	SCSI-2	875-1000
MC4221	2.05GB	8.5MS	SCSI-2	880-1055
MC1936	3.0GB	11MS	SCSI-2	750-900
MC3243	4.3GB	8MS	SCSI-2	1139-1239
MC1991	9.0GB	11MS	SCSI-2	2119-2254
MC4221AV	2.05GB	8.5MS	SCSI-AV	870-1020
MC1936AV	3.0GB	11MS	SCSI-AV	999-1199
MC3243AV	4.3GB	8.5MS	SCSI-AV	1239-1399
MC1991AV	9.1GB	10MS	SCSI-AV	2219-2344

WESTERN DIGITAL

FACTORY NEW-3 YEAR WARRANTY				INT-EXT
WDAC2630	630MB	11MS	IDE	$189-339
WDAC2850	850MB	10MS	IDE	199-349
WDAC31200	1.2GB	10MS	IDE	288-438
WDAC31600A	1.6GB	9MS	IDE	469-619

FUJITSU

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
M2684	530MB	13MS	IDE	$169-319
M2684S	530MB	13MS	SCSI	180-305
M1606S	1.1GB	9.5MS	SCSI	345-470
M2915S	2.1GB	9.5MS	SCSI	725-850
M2934S	4.3GB	8.9MS	SCSI	999-1024

SAMSUNG

FACTORY NEW-2 YEAR WARRANTY			INT-EXT
SA30854A850MB	12MS	IDE	$215-365
SA31084A1.08GB	11MS	IDE	249-365
SA31274A1.27GB	11MS	IDE	275-365
SA31625A1.62GB	11MS	IDE	CALL

REMOVABLES/OPTICALS

SYQUEST

REMOVABLE CARTRIDGE DRIVES

270MB INTERNAL/EXTERNAL FOR PC	$399/499
270MB EXT. FOR MACINTOSH	499
270MB CART. SINGLES/5 PACK	80/395
270 PARALLEL PORT	599
270MB INTERNAL IDE	399
CARTS. 44MB/88MB/105MB/200MB	54/69/75/85
5200 200MB INT/EXT	399/599

FUJITSU

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230MB 3.5" OPTICAL DRIVE INT	$699
230MB 3.5" OPTICAL DRIVE EXT	799
230MB 3.5" OPTICAL EXT FOR MAC	699
230MB CARTRIDGE....1-PACK $29 5-PACK	129

NETWORKING TERMINALS

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Link MC5 amber/green/white	329
Link MAX9000 amber/green/white	329
Link MC80 14" color	449
Wyse 60 amber/green/white	329
Wyse 160 amber/green/white	389

KEYBOARDS

MITSUMI 101	$25
FOCUS 2001 W/COVER	40
FOCUS 7000 KEYTRACK	59
FOCUS 9000 PROGRAMMABLE	65

MicroSolutions

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QUAD SPEED PARALLEL PORT CD ROM DRIVE	399
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DSKTTE DRV 1.4, 3.5	175
BACKPACK 250MB TAPE DRIVE	329
BACKPACK 900MB TAPE DRIVE	469
BACKPACK 420MB HARD DRIVE	469
BACKPACK 850MB HARD DRIVE	579

IOMEGA

Bernoulli 90 MB DR	345
Bernoulli 150MB Internal SCSI	413
Bernoulli 150MB Internal IDE	389
Bernoulli 230MB Insider SCSI	474
Bernoulli 230MB Transportable	474
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CONNER

TapeStor 420MB Internal	$169
TapeStor 420MB Parallel Port	319
TapeStor 850MB Internal	259
TapeStor 850MB Parallel Port	429
4320/50 Python 2GB up to 11MB int/ext	749-1039
4354XP Python 2GB Turbo 22MB/min ext	1099
4326NP Python 4-8GB 5MB/sec ext	976
4356XP Python 4-8GB w/comp1MB Cahe	1209
4324T Python 4GB Turbo int/ext	879-989

IBM PS/2

PS/2 50, 50Z, 60, 70, 80, P70, 55SX			
200MB	15MS	IDE	$349
420MB	13MS	IDE	399
540MB	12MS	IDE	499
540MB	12MS	SCSI	499
1.2GB	12MS	SCSI	799
MICROCHANNEL CONTROLLER			
IDE	169	SCSI-2	$179
IBM PS/2 INTERNAL DRIVE KITS 30-8086,30-286,25-8086, 25-286			
210MB		IDE	$249
420MB		IDE	299
540MB		IDE	349
1.0GB		IDE	449

IBM STANDARD

			INT-EXT
527MB	12MS	SCSI	$265-385
1.0GB	10MS	SCSI	599-724
2.04GB	7.5MS	SCSI	1300-1425
4.25GB	11MS	SCSI	2149-2274
527MB	12MS	IDE	246-396
728MB	12MS	IDE	325-475
1.05GB	10MS	IDE	569-719

digital

FACTORY NEW-2 YEAR WARRANTY				INT-EXT
DSP3107	1GB	9.5MS	SCSI	$794-919
DSP3210	2GB	9.5MS	SCSI	1149-1274
DSP5300	3GB	12MS	SCSI	1299-1324
DSP5400	4GB	12MS	SCSI	2479-2604

HEWLETT PACKARD

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
C3724A	1.2GB	9.5MS	SCSI	$415-540
C2490	2.1GB	8.9MS	SCSI	999-1124

Quantum

MAVERICK - 2 YEAR WAR.				INT-EXT
30540MVA	540MB	14MS	IDE	$165-329
30540MVS	540MB	14MS	SCSI	176-314
LIGHTNING - 2 YEAR WAR.				**INT-EXT**
30540LTA	540MB	11MS	IDE	$189-339
30540LTS	540MB	11MS	SCSI	199-324
30730LTA	730MB	11MS	IDE	188-313
30730LTS	730MB	11MS	SCSI	227-377
FIREBALL SERIES - 3 YEAR WAR.				**INT-EXT**
30540FBA	540MB	12MS	IDE	170-295
30540FBS	540MB	12MS	F.SCSI-2	179-304
31080FBA	1.08GB	12MS	IDE	244-369
31080FBS	1.08GB	12MS	F.SCSI-2	359-484
TRAIL BLAZER SERIES - 3 YEAR WAR.				**INT-EXT**
30420TRA	420MB	12MS	IDE	145-270
30420TRA	420MB	12MS	F.SCSI-2	188-304
30850TRA	850MB	12MS	IDE	196-474
30850TRA	850MB	12MS	F.SCSI-2	239-394
EMPIRE SCSI 2 SERIES - 5 YEAR WAR.				**INT-EXT**
EMP1080S	1.0GB	8.9MS	3.5"	569-694
EMP2100S	2.1GB	8.9MS	3.5"	689-814
CAPELLA SCSI SERIES - 5 YEAR WAR.				**INT-EXT**
VP32210S	2.2GB	8.5MS	3.5"X1	689-814
ATLAS SCSI 2 SERIES - 5 YEAR WAR.				**INT-EXT**
XP32150S	2.1GB	8MS	7200RPM	829-954
GRAND PRIX SCSI 2 SERIES-5 YEAR WAR.				**INT-EXT**
GP34301S	4.3GB	8.8MS	7200RPM	999-1124
GP34301W	4.3GB	8.8MS	7200RPM	1299-1424

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4MB X 9-60NS SIMM 9 CHIP	169
1MB X 9-100NS 9 CHIP SIMM	40
1MB X 9-80NS 3 CHIP SIMM	42
1MB X 9-80NS 9 CHIP SIMM	44
1MB X 9-70NS 3 CHIP SIMM	42
1MB X 9-70NS 9 CHIP SIMM	44
1MB X 9-60NS 3 CHIP SIMM	42
1MB X 9-60N5 9 CHIP SIMM	48
16MB X 9-70NS SIMM	595
16MB X 9-60NS SIMM	625
256K X 9-80NS SIMM	14
256K X 9-70NS SIMM	15
256K X 9-60NS SIMM	18
30 PIN NON-PARITY/8 BIT	
1MB X 8-80NS SIMM	40
1MB X 8-70NS SIMM	40
z4MB X 8-80NS SIMM	145
4MB X 8-70NS SIMM	150
4MB X 8-60NS SIMM	155
30 PIN 9 BIT SIPPS	
1MB X 9-100NS SIPP	43
1MB X 9-80NS SIPP	49
1MB X 9-70NS SIPP	50
1MB X 9-60NS SIPP	51
256K X 9-80NS SIPP	19
256K X 9-70NS SIPP	20
72 PIN/36 BIT PARITY	
256X36-1MB-70NS	55
512X36-2MB-70NS	95
1X36- 4MB-70NS/60NS	165/175
1X36- 4MB-70NS/60NS MAJOR	175/185
2X36-8MB-70NS/60NS	330/350
2X36-8MB-70NS/60NS MAJOR	350/360
4X36-16MB-70NS/60NS	535/545
4X36-16MB-70NS/60NS MAJOR	650/660
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DIAMOND Computer Systems, Inc

Speedstar Pro 1MB ISA, VLB	$105
Speedstar 64 1MB/2MB ISA	149/195
Stealth 64 DRAM 1MB VLB/PCI	149
Stealth 64 DRAM 2MB VLB	199
Stealth 64 VRAM 2MB PCI/VLB	329
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WIDE SCSI HARD DRIVES

CONNER

FACTORY NEW-5 YEAR WARRANTY				
CPF1080W	1.08G	10MS	3.5	$749

Seagate

FACTORY NEW-5 YEAR WARRANTY				
ST32550W	2.13GB	8MS	3.5X1"	$1069
ST15230W	4.3GB	9MS	3.5X1"	1099
ST15150W	4.3GB	8MS	3.5"	1489
ST410800W	9.0GB	11MS	5.25"	2325
ST15150WD	4.3GB	8MS	3.5"	1569
ST410800WD	9.0GB	11MS	5.25"	2379

MICROPOLIS

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MC3243W	4.30GB	8.5MS	3.5	1439
MC1991W	9.10GB	10MS	FH	2259
MC4221WAV	2.05GB	8.5MS	LP3.5	999
MC3243WAV	4.30GB	8.5MS	3.5	1389
MC1991WAV	9.10GB	10MS	FH	2369

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PX-43CS 4-Speed, 1MB Cache Int/Ext	399-529
PX-43CH External 4-Speed, 1MB Cache	529
PX-45CHM Ext 4-Speed, 1MB Cache MAC	529
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CDS545 Quad Speed IDE Int/Ext	$179-329
CDS525 DS SCSI II Int/Ext	125-250

MITSUMI

CRMC-FX400 Quad Speed Int/Ext IDE	$189-325

SONY

CDU-55E 2X Int/Ext	$149-274
CDU-555 SCSI 2X Int/Ext	165-290
CDU-765B SCSI 4X Int/Ext	249-399
CDU-76 IDE 4X Int/Ext	229-349

TOSHIBA

3601 SCSI 4X Internal/External	309-453
XM5302A Quad Speed IDE Int/Ext	199-349

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Sportster VI 14.4/14.4 Int/Ext	119-139
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TMC1610	16-Bit ISA CDROM KIT	65
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KT910A	PCI/IDE Cache Controller	168

intel

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BOCA

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MBBRV144I	14.4/14.4 Sound Expression Int	159
MBBRV28V34I	28.8/14.4 Modem 28.8 Int	169
MBBRV28V34E	28.8/14.4 Modem 28.8 Ext	189

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4X9-80-70-60
4X3-80-70-60
16X9-70-60
1X2-80-70-60
1X8-100-80-70-60
4X8-80-70-60
16X8-80-70-60

72 PIN
256X36-70-60
512X36-80-70-60
1,2,4X36-80-70-60
2,4,8,16X36-80-70-60

72 PIN
256X32-70-60
512X32-70-60
1,2X32-70-60
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1MB X 1-80NS	6.25	256K X 1-70NS	3.75
1MB X 1-70NS	6.50	256K X 1-60NS	3.75
1MB X 1-60NS	6.75	256K X 4-100NS	6.00
256K X 1-150NS	3.00	256K X 4-80NS	6.25
256K X 1-120NS	3.25	256K X 4-70NS	6.50
256K X 1-100NS	3.50	256K X 4-60NS	6.75

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8 X 8-15	$5.00	32 X 8-25	7.80
8 X 8-20	4.50	64 X 1-15	15.00
8 X 8-25	4.00	128 X 8-20	33.00
32 X 8-15	10.00	128 X 8-25	30.00
32 X 8-20	8.00	128 X 8-15	40.00

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INTEL		80287XLT 12MHZ	75	80487SX-25	345	83S87SX20 20MHZ	59	3087-16 16MHZ	59
8087-5MHZ	$40	80387SX-16 16MHZ	75	**CYRIX**		83S87SX25 25MHZ	59	3087-20 20MHZ	59
8087-2 8MHZ	130	80387SX-20 20HZ	75	83D87DX-16 16MHZ	59	82S87XL	59	3087-25 25MHZ	59
8087-1 10MHZ	80	80387SX-25 25HZ	75	83D87DX-20 20MHZ	59	**IIT**		3087-33 33MHZ	59
80287-6 8MHZ	49	80387DX-16 16MHZ	75	83D87DX-25 25MHZ	59	2087-8 8MHZ	54	3087-40 40MHZ	69
80287-8 8MHZ	50	80387DX-20 20MHZ	75	83D87DX-33 33MHZ	59	2C87-10 10MHZ	54	3S87SX-16 16MHZ	59
80287-10 10MHZ	75	80387DX-25 25MHZ	75	83D87DX-40 40MHZ	69	2087-12 12MHZ	60	3S87SX-20 20MHZ	59
80287XL 10MHZ	75	80387DX-33 33MHZ	75	83S87SX16 16MHZ	59	2087-20 20MHZ	64	3S87SX-25 25MHZ	59
								3S87SX-33 33MHZ	59

CPU's

INTEL		**INTEL**		**AMD**	
386DX-33	$45	486DX4-100	213	386DX-40	$45
486SX-25	89	PENTIUM 60	245	486DX2-66	95
486SX-33	89	PENTIUM 66	300	486DX2-80	105
486DX-25	89	PENTIUM 75	295	486DX4-100	110
486DX-33	125	PENTIUM 90	395	486DX4-120	213
486DX2-50	114	PENTIUM 100	495	**CYRIX**	
486DX-50	249	PENTIUM 120	795	486DX2-33	89
486DX2-66	147	PENTIUM 133	995	486DX2-50	89
486DX4-75	183			486DX2-66/80	89

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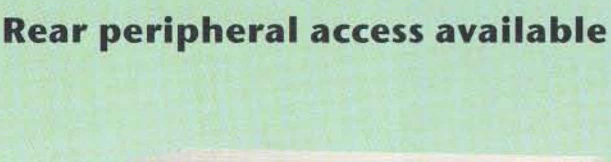

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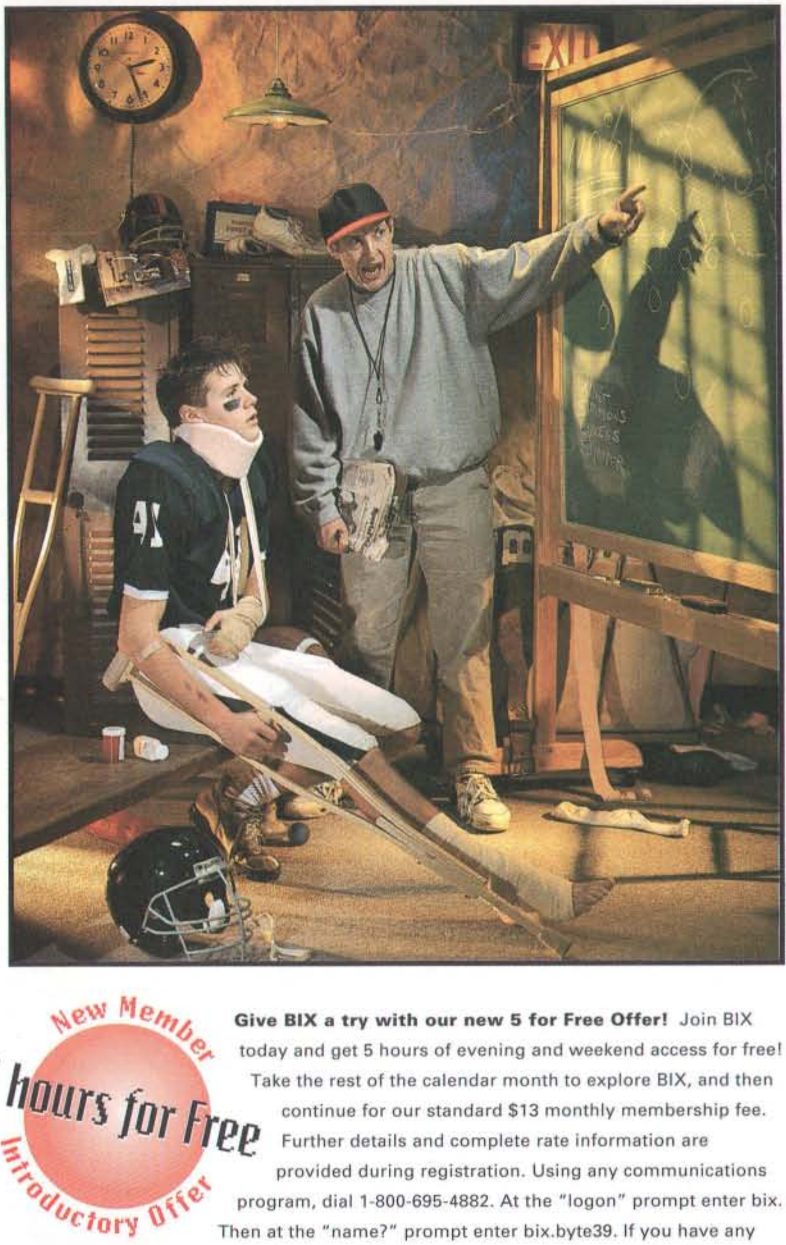

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	16MB	501566-001	$609
	32MB	501567-001	$1,179
	64MB	501568-001	$2,199
NEW Premmia MTE, SE P/60	4MB	501159-001	$190
	8MB	501159-002	$357
	16MB	501159-003	$712
	32MB	501159-004	$1220
Bravo 386-SX, WS/286, 386	2MB	500510-002	$88
	4MB	500510-008	$195
Bravo 3/25s	2MB	500710-004	$89
	8MB	500824-002	$306
Advantage! Plus 486DX/33; DX2-50; DX2-66	4MB	501168-001	$158
	8MB	500824-001	$329
Advantage! and Advantage! Pro 386SX/20, 25, Bravo 3/33s	2MB	500962-001	$80
	8MB	500962-002	$272
Advantage! Pro 486DX/33; SX/25 Bravo LC, MS	256K cache	501284-004	$69
Special	4MB	500987-002	$159
	1MB Video Upgd	501507-001	$72
	16MB	500987-004	$589
	32MB	500987-005	$1,179
Premium 386/25; 33; 33T and Premium II 386SX/16; 20, 25	1MB	500780-003; 002	$45
Premium 386/33T, 386SX/16 and Premium II 386SX/20; 25	4MB	500780-004	$174
Advantage! 486/25; 33; 33p; SX20, Premium Server SE 4/33 Power Premium and Premium TE all models Premium II 386/25; 33, 486/33, 486SX/20	8MB	500780-001	$298

DELL

Model	Size	Part No.	Price
NEW OptiPlex ME and V models, PowerEdge XE models Performance L, M and T models	4MB	310-3325	$151
	16MB	310-3327	$525
Power Desktop and Low Profile Power Desktop models	1MB	310-2505	$49
	4MB	310-2507	$151
	16MB	310-2625	$575
Dimension P75, P90, P100T, P75T, XPS (all models)	4MB	n/a	$159
	8MB	n/a	$291
	16MB	n/a	$569
	32MB	n/a	$1,119
Performance ME models	8MB	310-3335	$305
	32MB	310-3337	$1120

ZENITH

Model	Size	Part No.	Price
NEW Z-400+, Z-Station 5Eh, 5En, 5h, 5n, DEh, Dh and Xen Z-300/400 Series, Z-430/SX, Z-425/SX, Z-433/DX, SX	4MB	ME-100	$169
	16MB	ME-90	$613

COMPAQ

Model	Size	Part No.	Price
NEW Presario 500, 700 and 900 series	4MB	147522-001	$159
	8MB	147523-001	$291
	16MB	147524-001	$569
	32MB	147525-001	$1,119
NEW ProLiant 2000 and 4000 series, Systempro XL	16MB	149940-001	$709
	32MB	149912-001	$1426
	64MB	149913-001	$2436
	128M	149914-001	$4505
ProLinea 3/25s; 3/25zs	2MB	141738-001	$89
	8MB	141742-001	$304
NEW Presario 600 and 800 series, ProLinea 4/25, 4/33, 4/50, 4/66 ProLinea MT and ProLinea Enhanced series, ProSignia VS	4MB	141684-001	$153
	8MB	141685-001	$307
DeskPro 386-20; 25, 386-20e, 25e	1MB	113131-001	$62
	4MB	113132-001	$167
DeskPro 386s/16	4MB	112534-001	$194
	4MB brd	113634-001	$287
DeskPro 3/25i; 33i, 4/25iS, 33i, 66i, 286N; 386N; SX/20; 20N, SystemPro LT and M Series	4MB	118690-001	$153
	8MB	118877-001	$356
ProSignia PC Server 486/33; DX2/66	16MB	149520-001	$610
	32MB	149147-001	$1152
DeskPro 386-33, 486-33, SystemPro and SystemPro E series	2MB	115144-001	$109
	8MB	116561-001	$376

HEWLETT-PACKARD

Model	Size	Part No.	Price
NEW Vectra VL2, XP, XU, M2, N2 and XM2 models Netserver LM, LC and LF models	4MB	D2974A	$169
	8MB	D2975A	$329
	16MB	D2297A	$613
	32MB	D2298A	$1,119
Vectra QS and RS models	4MB	D1542 or 1642A	$177
Vectra 486 M, ML, N, NI and XM models	2MB	D2381A	$95
	8MB	D2152A	$305
	4MB	D2156A	$151
	16MB	D2676A	$611
Vectra 386/25, 486/25U; 33U; 33ST, 50U; 66U and 66ST	2MB	D2381A	$95
	8MB	D2152A	$329
NEW Vectra 386/33N, NI models	2MB	D2714A	$92
	8MB	D2715A	$304

NEC

Model	Size	Part No.	Price
NEW Image 425, 433, 466	4MB	410-12002	$159
	16MB	410-12003	$569
Ready 425, 433	4MB	n/a	$159
	16MB	n/a	$569
PowerMate 386/33i; Express Te, e models	4MB	OP410-6205	$169
	16MB	OP410-6206	$613
PowerMate SX Plus	2MB Board	n/a	$163
	4MB Board	n/a	$278
PowerMate SX/20	2MB Upgrade	OP-410-8101	$151
	2MB Board	OP-410-8102+8103	$171
PowerMate 386/20; 25	2MB	APC-H655	$219
	8MB	APC-H656	$598
PowerMate 386/33E, 486/25E	2MB	OP-410-5101	$171

IBM

Model	Size	Part No.	Price
NEW Aptiva 300, 500 and 700 series	4MB	n/a	$159
	16MB	n/a	$509
NEW Eduquest 55	4MB	74G1299	$174
NEW Eduquest 30, 40 and 50 models	4MB	60G0896	$174
	16MB	60G0898	$549
PS/1 286, 386SX	2MB	92F9935	$83
	4MB	92F9694	$163
NEW Valuepoint Performance models	4MB	92G0201	$169
	8MB	92G7520	$329
PS/1 Consultant, Essential, Expert models x43, x44. PS/Valuepoint all models except Cxx models	4MB	96F9290	$177
	16MB	96F9291	$609
PS/1 Consultant, Essential, Expert models	16MB	96F9291	$609
PS/2 25/286, 30/286	2MB	30F5360	$79
PS/2 35SX; LS, 40SX, 50Z, 55SX; LS, 65SX; LS, 70, XStation	2MB	6450604	$87
PS/2 70-A21; A61; B21; B61, PS/Valuepoint Cxx models PS/1 Consultant, Essential, Expert models	2MB	6450608	$95
PS/2 35SX; LS, 40SX, 55SX; LS, 65SX; LS, XStation, PS/Valuepoint Cxx models	4MB	34F2933 or 87F9977	$179
PS/2 35SX; LS, 40SX, PS/Valuepoint	8MB	6450129	$329
PS/2 90 XP, 95 XP, P75 (pairs) 56, 57 (all) PS/1 Pro M2123	2MB	6450902	$85
PS/2 90 XP, 95 XP, P75 (pairs) 56, 57 (all models) PS/1 Consultant, Essential, Expert models, PS/1 Pro M2123	4MB	6450128	$169
	8MB	6450130	$329
PS/2 80-111; 311; 121; 321; 081; 161	2MB	6450379	$49
PS/2 80-A21; A31; A16	4MB	6451060	$186
Expansion boards for PS/2 80286 based models	4-16MB w/4MB	6450609 (use 72-pin)	$299
Expansion boards for PS/2 80386 based models	2-14MB w/2MB	34F3077	$205
	4-16MB w/4MB	34F3011	$299

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16 x 9-70ns (16MB).......$534	4 x 36-70ns (16MB).......$494

First Source International Always Includes Installation Instructions! (on standard simms)

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Model	Size	Part No.	Price
Canon LBP-4	1.5MB	n/a	$109
	2MB	n/a	$159
Canon LBP-8II, IIR, IIT	2MB	S63-1880	$119
Epson ActionLaser 1000, 1500	512K	n/a	$35
	2MB	n/a	$99
NEW Epson ActionLaser 1100	2MB	n/a	$105
	4MB	n/a	$159
Epson ActionLaser 1600	4MB	n/a	$159
	16MB	n/a	$609
HP LaserJet 4L	1MB	C2024A	$48
HP LaserJet IIP, III, IIIP, IIID	2MB	33475B	$95
	4MB	33477B	$169
HP LaserJet II, IID	2MB	33444B	$95
	4MB	33445B	$169
HP LaserJet IIIsi, 4, 4M, 4Si, 4SiMX, XL300, DeskJet 1200c	1MB	C2063A	$48
	2MB	C2064A	$94
	4MB	C2065A	$174
	8MB	C2066A	$339
NEW HP LaserJet 4P, 4MP, Color LaserJet	2MB	C3131A	$95
	4MB	C3132A	$179
NEW HP DeskJet 500, 500C, 520, 520C, 550C, 560, 560C	256K	22707B	$40
NEW HP DesignJet 5P, 5MP	4MB	C3132A	$170
	8MB	C3133A	$329
IBM/Lexmark Laser 4019 (all models)	2MB	1038675	$107
	3.5MB	1039137	$167
IBM/Lexmark Laser 4029 (all models)	2MB	1183334	$87
	4MB	1183335	$157
IBM/Lexmark Laser 4039, 4079 (all models)	4MB	1328363	$157
	8MB	1328365	$319
OkiLaser 400	1MB	70014701	$69
	2MB	n/a	$97
NEW OkiLaser 400e, 410e	2MB	n/a	$117
	4MB	n/a	$197
OkiLaser 830, 830 Plus, 840	2MB	n/a	$124
	4MB	n/a	$209
Panasonic LaserPartner 4400, 5400	2MB	KX-PEM1	$110
	4MB	KX-PEM2	$204
Panasonic LaserPartner 4410, 4430	2MB	KX-P444	$115
	4MB	n/a	$196
Panasonic LaserPartner 4450i, 4420	2MB	KX-P441	$116
	4MB	n/a	$187

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LAPTOP & NOTEBOOK MEMORY

AST

Model	Size	Price
Ascentia 800N, 810N	4MB	$189
	8MB	$359
	16MB	$699
NEW Ascentia 900N, 910N	4MB	$192
	8MB	$359
	16MB	$699
NEW Ascentia 950N (Special)	8MB	$424
	16MB	$739

COMPAQ

Model	Size	Price
Compaq Elite	4MB	$189
	8MB	$359
	16MB	$699
NEW Contura 410	4MB	$185
	8MB	$359
	16MB	$699
Contura 4/25	4MB	$179
	8MB	$339
	16MB	$679
Contura Aero	4MB	$185
	8MB	$329
	16MB	$699

Digital

Model	Size	Price
Hi-Note	4MB	$179
	8MB	$349
	16MB	$619
NEW Hi-Note Ultra	4MB	$179
	8MB	$349
	16MB	$619

IBM

Model	Size	Price
NEW ThinkPad 360	4MB	$189
	8MB	$359
	16MB	$599
	32MB	$1,579
NEW ThinkPad 701	4MB	$189
	8MB	$379
	16MB	$659
ThinkPad 730	8MB	$559
NEW ThinkPad Power 820	MB	CALL
NEW ThinkPad Power 850	MB	CALL
NEW ThinkPad 755	4MB	$199
	8MB	$389
	16MB	$679
	32MB	$1,379
NEW ThinkPad 700, 720 and CL57SX (Special)	4MB	$199
	8MB	$339
	16MB	$669
	32MB	$1399
NEW ThinkPad 710T	4MB	$179
	8MB	$314
N51 Notebook	4MB	$179

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Microsoft Windows 95

"Upgrade to 16MB of memory– it is worth the investment"
– Windows Sources Magazine, April 1995

"Memory has a bigger impact on Windows 95's performance than any other single component. If you don't have at least 16MB of RAM, prepare to upgrade."
– Windows Sources Magazine, April 1995

NEC

Model	Size	Price
NEW Versa 2000	4MB	$189
	8MB	$369
	16MB	$639
NEW Versa S	4MB	$179
	8MB	$359
	16MB	$619
NEW Versa V, M, P	4MB	$189
NEW Versa 4000	8MB	$359
	12MB	$599
	16MB	$619
	32MB	$1,439

Texas Instruments

Model	Size	Price
NEW Extensa 450	4MB	CALL
	8MB	CALL
	16MB	CALL
NEW Extensa 550	8MB	CALL
	16MB	CALL
	32MB	CALL
TravelMate 4000M, 4000E	4MB	$189
	16MB	$799
NEW TravelMate 5000	8MB	$499
	16MB	$899

Toshiba

Model	Size	Price
T2100, T2110, T2130, T2150, T2155, T2105 (Special)	4MB	$172
	8MB	$335
	16MB	$679
	24MB	$999
T1900, T4500, T4600, T4700, T4800, T4850, T4900	4MB (3.3V)	$189
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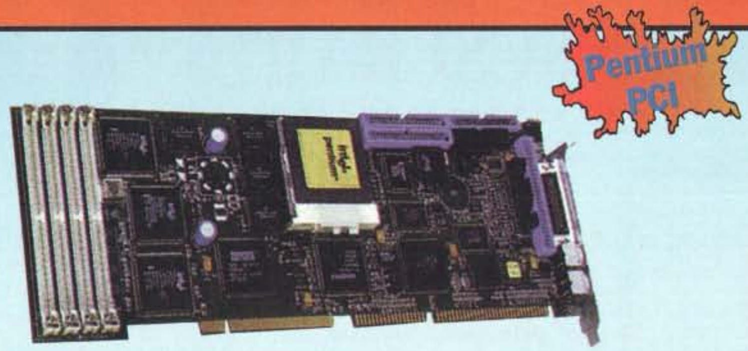

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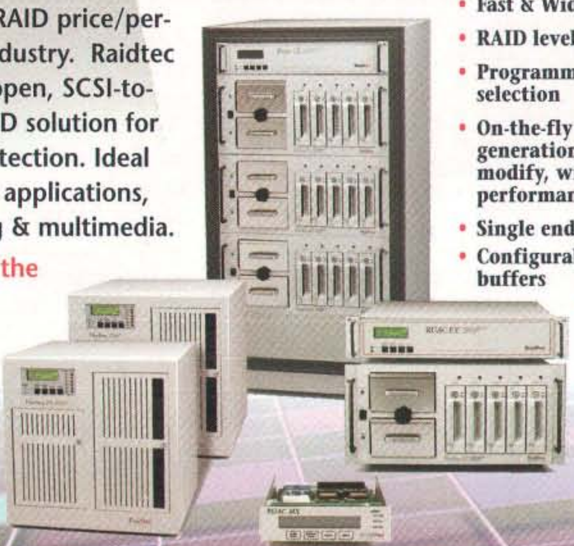

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6451060 (4Meg)	80-A21, A-61, 80-A31, 80-111, 80-311	189.00
6450604/92G7196 (2Meg)	70-061, E61, 121, 502, 555X, 655X, P-70, 55LS, 65LS, X-Station 120 & 130, 35SX, 35LS, 40SX	99.00
6450608 (2Meg)	70-A21, A-61, B-21, B-61, 35SX, 35LS, 40SX, Val Pt. 325T	90.00
78X8955 (128K)	25	35.00
34F2933 (4Meg)	35SX, 40SX, 55SX, 65SX, 55LS, 65LS	169.00
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1057035 (512K)	P/S1-286	49.00
92F9935 (2Meg)	P/S1 & P/S1/386SX-2121	109.00
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92G7200 (4Meg)	PSI Expert, Consultant, Willow	169.00
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92G7539 (4Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730	164.00
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6450128/92G7200 (4Meg)	57SX, 90, 95, P-75, 57SLC, 56, 56SLC, P/S1, 386SX, Mod-2123, 2133, 2155, Val Pt.77, 486CS2, 486SX, SVR85, Value Point 77 486DX2, 486SX, SVR 85	169.00
6450129/92G7428 (8Meg)	35SX, 40SX	349.00
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79F1000 (4Meg)	LX40, N33SX, PS Note, Tkpd 350, 350c, PS Note 425	189.00
79F1001 (8Meg)	LX40, N33SX, PS Note	349.00
Hard Drive (524Meg, 710 Meg)	Thinkpad 750, 755, 360, 355	829/929
(4Meg/16Meg)	Thinkpad 755 Dimm Modules	199/749
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60G0378 (8Meg)	Thinkpad 350, 350c, PS Note 425	339.00
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92G7259 (4Meg)	Thinkpad 701C, CS, Butterfly	189.00
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	1Meg Module	113646-001	79.00
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Prosignia 5/60	16Meg Kit	149949-001	676.00
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Proliant 4000 4/50, 5/66	128Meg Kit	149914-001	5076.00
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T4400SX, SXC T6400, T6600	8Meg	PC-PA2005U	379.00
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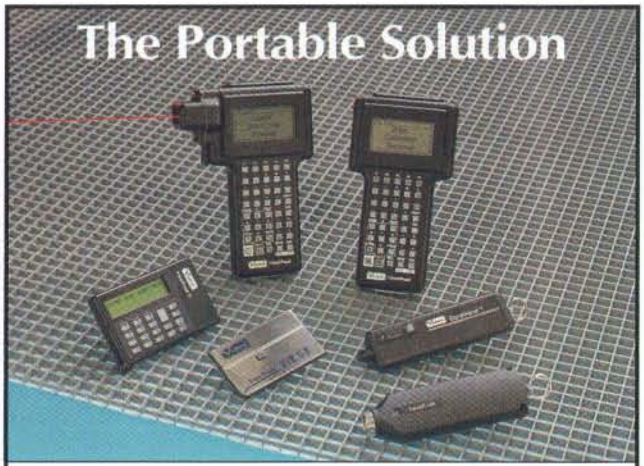

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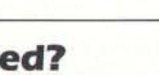

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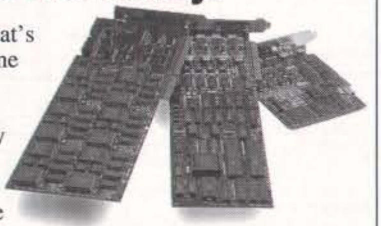

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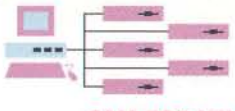

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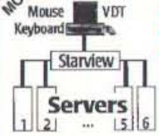

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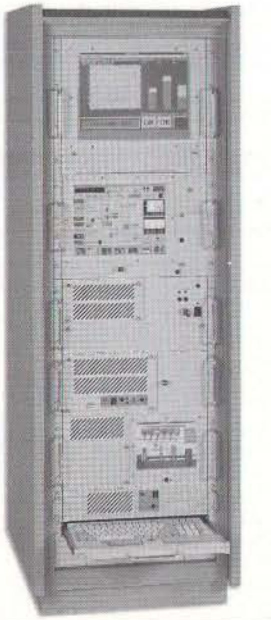

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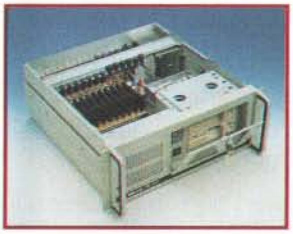

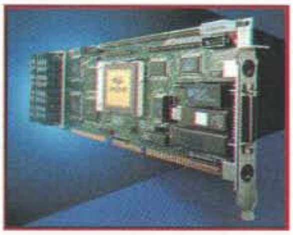

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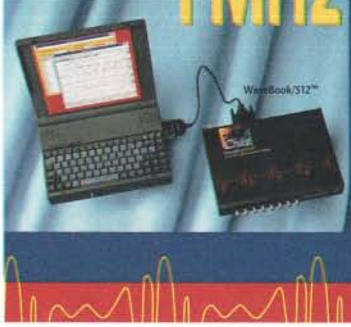

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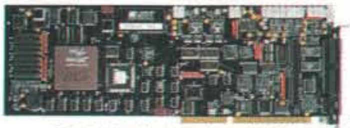

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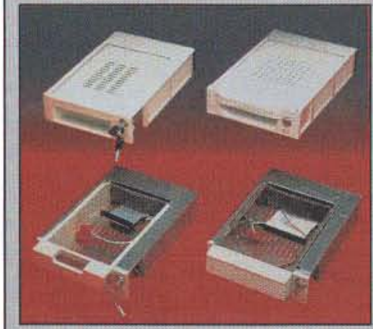

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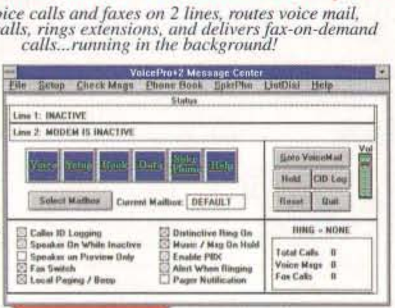

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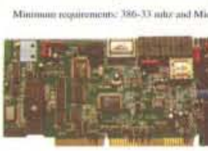

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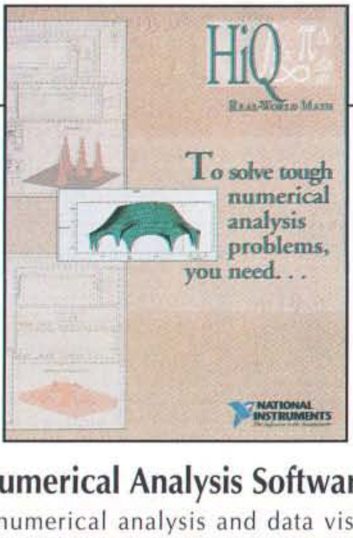

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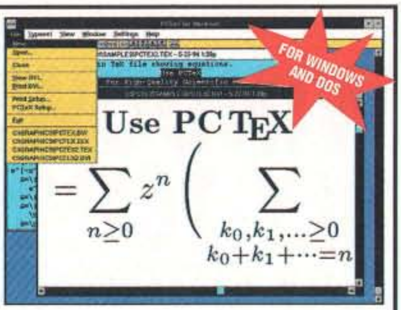

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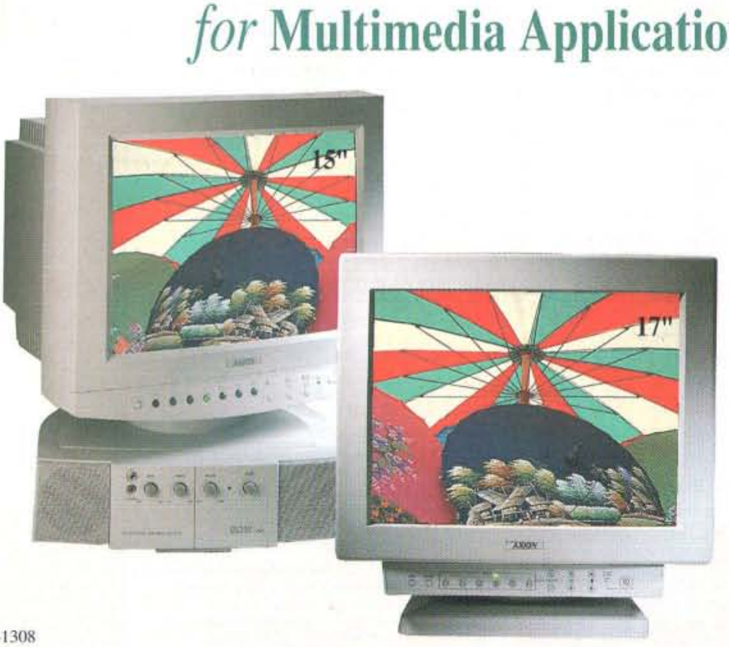

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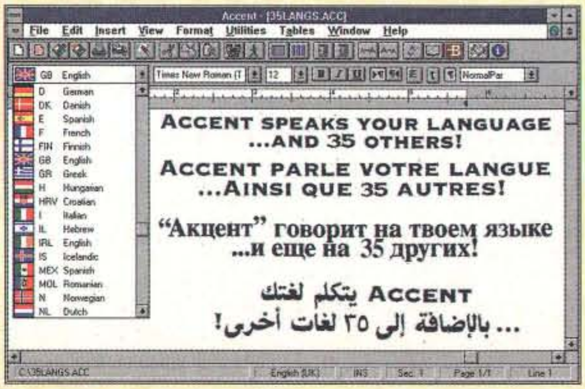

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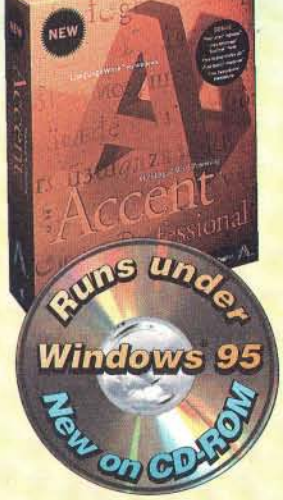

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Things to Come

The inventor of hypertext forecasts the future, including the demise of the human race

Desktop computers

Very few computers will be on the desktop in 10 years. Today's workstation capacity will be in wristwatches, on the wall, off the wall, and so on.

Mobile computers

My favorite design, which I call the Walkie-Thinkie, is a wearable computer with a five-finger keyboard on your lapel (but there are lots of other options), a headphone, and a microphone. This device will have real-time digital recording and audio editing, a telephone, an answering machine, and voice mail built in. But I'm not holding my breath for reliable voice recognition.

User interfaces

It won't be the Mac/Windows-type interface or the voice interface seen in *Star Trek*. Both ideas are inane. The alternative is the design of abstract worlds and spaces with new rules and topologies that people can easily understand, use, and enjoy. Everybody should have the interface they want, so it will be increasingly important for "applications" to be delivered detached from "interfaces."

Operating systems

Linux will become very important. Then Taos, a very strong multitasking system for real-time (i.e., time-compelling) applications, set-top boxes, and so on.

Virtual reality

That oxymoron for interactive realism will become just another interface and another big way to waste time. But it could also be very practical for lots of stuff—maps, instructions, and x-ray views.

On-line publishing

As I've always envisioned (and built into Project Xanadu), there will be: automatic royalty on a pro rata basis for any portion of a document or object sold; stable publishing, so that materials may be reliably linked; unrestricted republication of any material, if that material uses Xanadu's "transcopyright" doctrine (i.e., a permission system that lets anyone reuse someone else's transcopyrighted material in a new document; you transmit a pointer to the desired material, and each customer purchasing your work buys each quotation from its original publisher).

Software-development tools

C++ will sink, C will resurge, Visual Basic (which ought to be called Structured COBOL) will be big. Prograph, possibly the best, will catch on. CASE tools will become convenient.

Componentware

We need a king to make the rules about how the components divide and fit together. Standardization politics rules. But most of the issues of software will change completely, just as they have every five years.

Tomorrow's killer applications

My hope is that there will be no more applications, because future software will be set up to be tied together, piped together, scripted together. The real killer applications will be nanotech bugs that escape.

Players of the twenty-first century

Microsoft has peaked. By 2000, it should be second to Netscape. Silicon Graphics will live on. So will Sun. Thinking Machines will make a comeback. Apple will be acquired by Wal-Mart. Quarterdeck will make it big, but I'm not sure what with. IBM will die a terrible death, possibly bankruptcy or being acquired by Quarterdeck.

The data highway

It will be a conglomerate of parts on an Internet-like model, with some fast priority lanes and something like the Clipper chip for encryption—which everyone will bypass. But that doesn't matter, since it will let the government arrest whomever they choose, since we'll all be breaking the big, vague new law against everything.

How computing technology will change the world

In every possible way. But I find it hard to believe that the human race will survive to the year 2100. ■

Ted Nelson coined the concepts hypertext and hypermedia in 1965. He is best known for Project Xanadu. You can reach him on the Internet or BIX at editors@bix.com.

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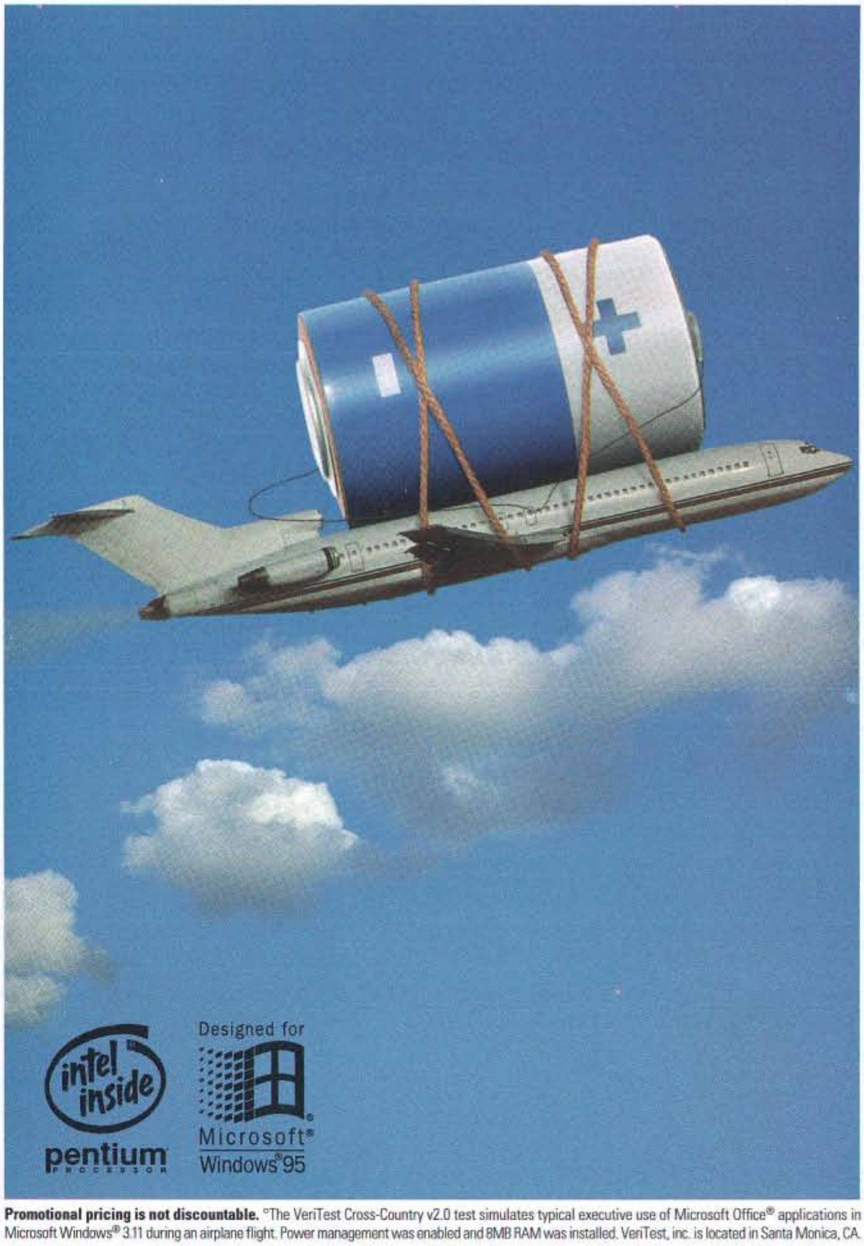

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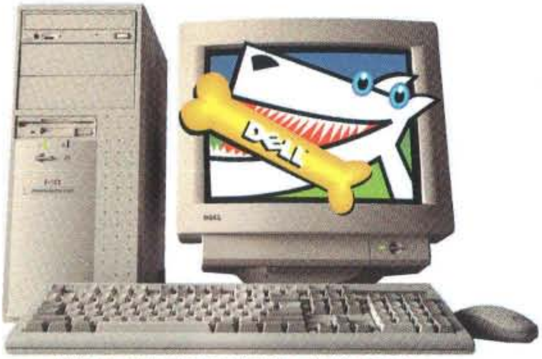

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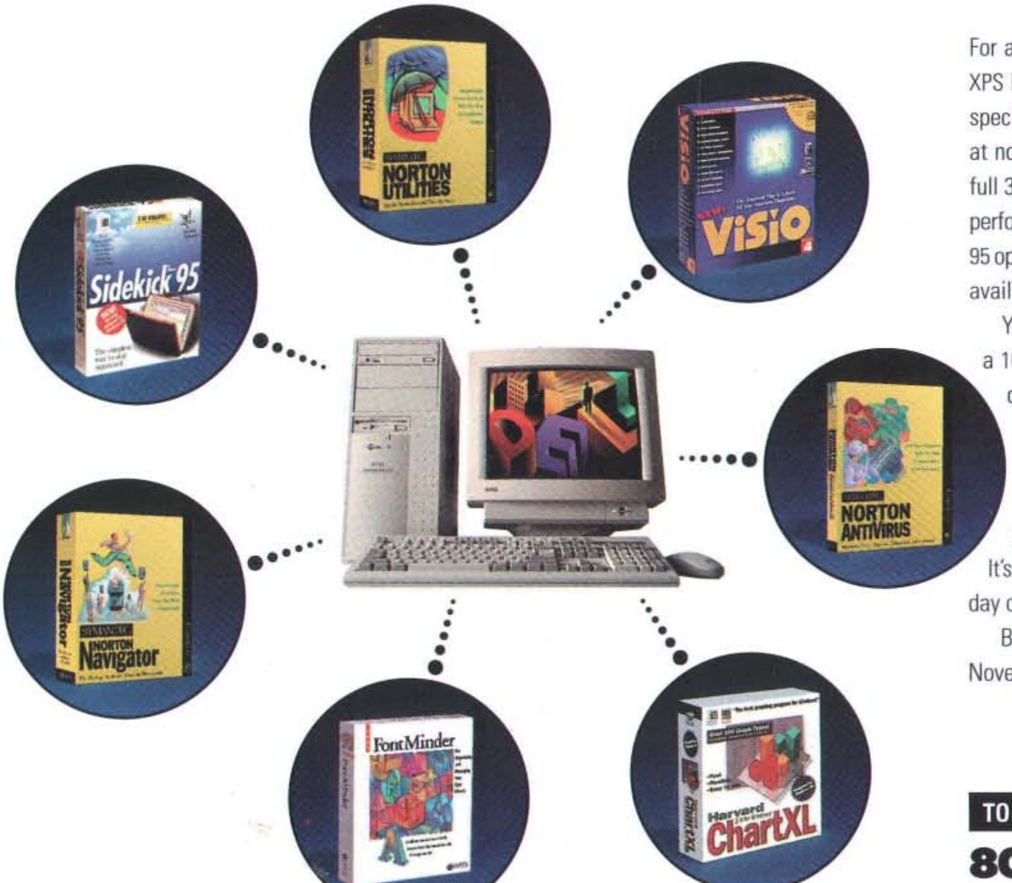

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PC MAGAZINE EDITORS' CHOICE

May 16, 1995
P90 HOME MPC

PC WORLD WORLD CLASS 1995

July 1995
P90 HOME MPC

intel inside pentium PROCESSOR

P75 HOME MPC

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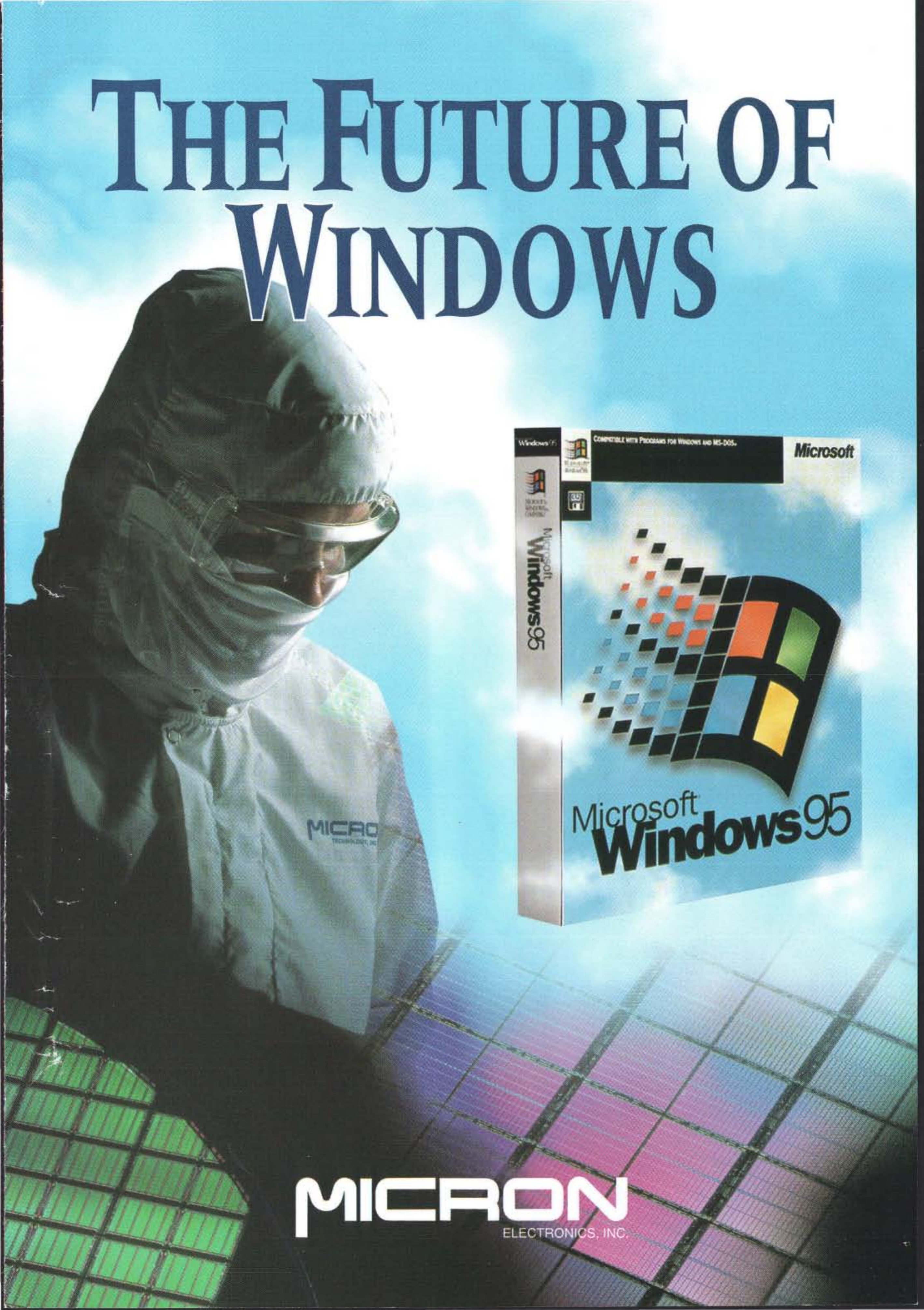
THE FUTURE OF WINDOWS
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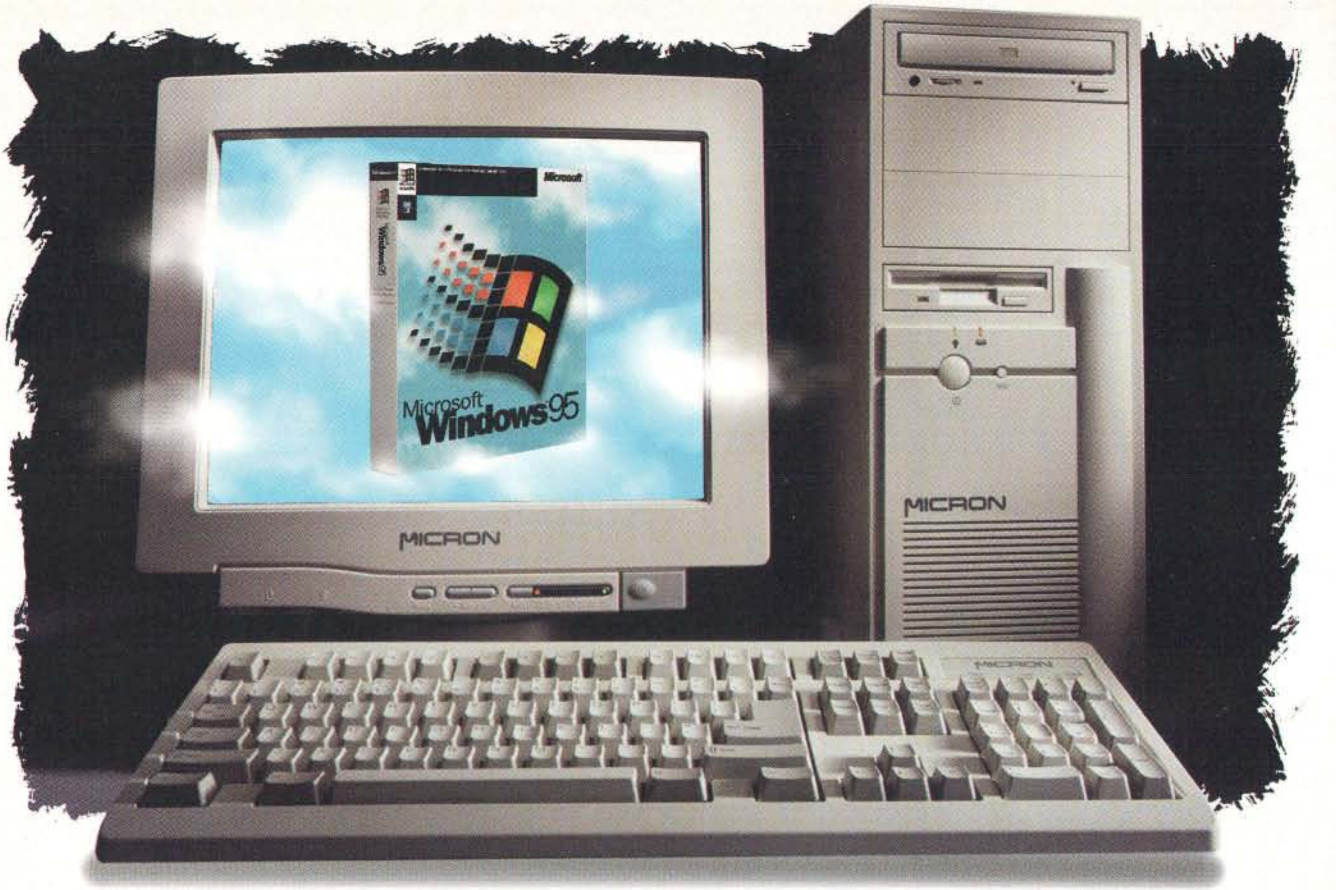

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PC MAGAZINE EDITORS' CHOICE
May 30, 1995
P120 MILLENNIA

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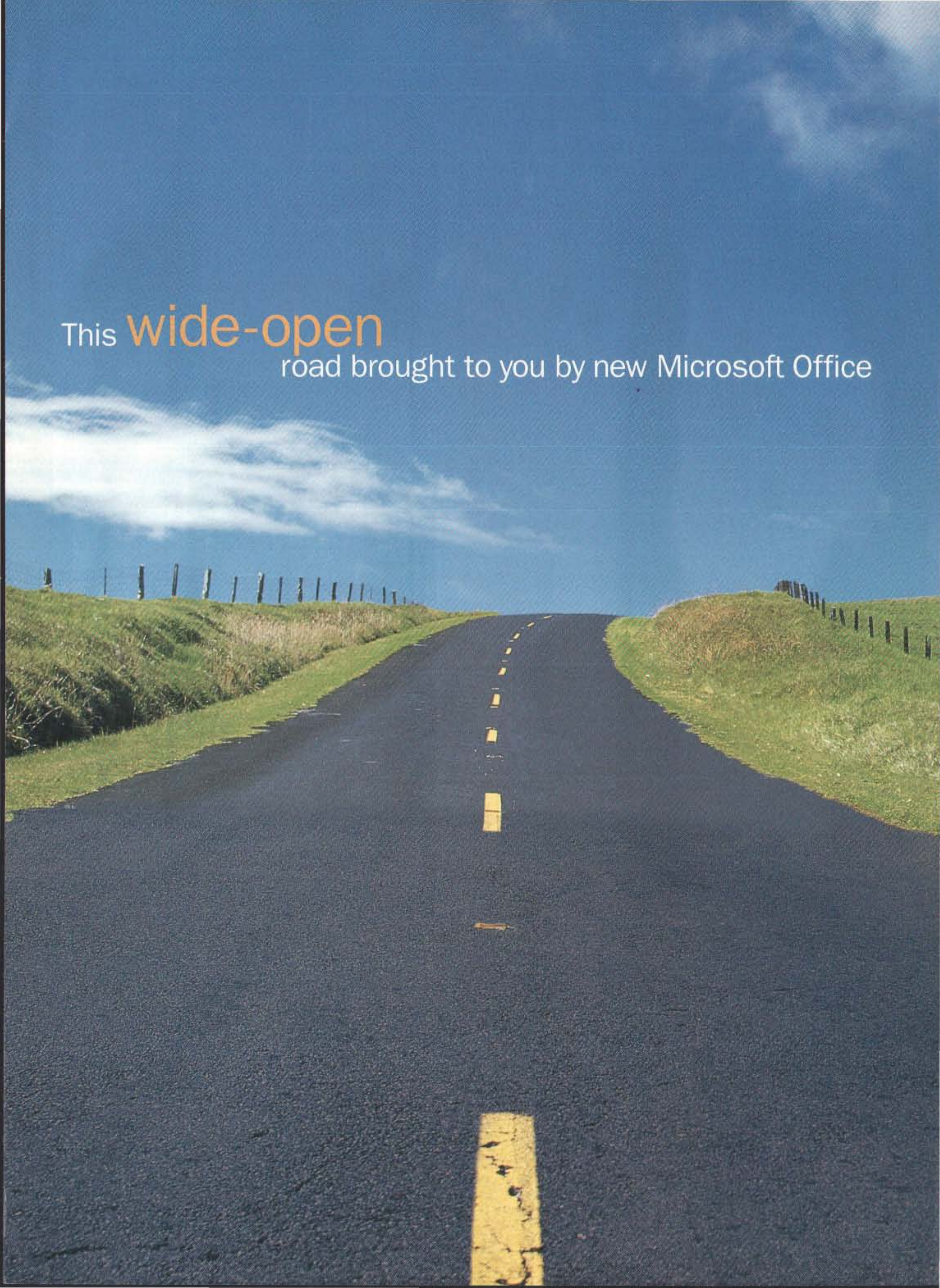
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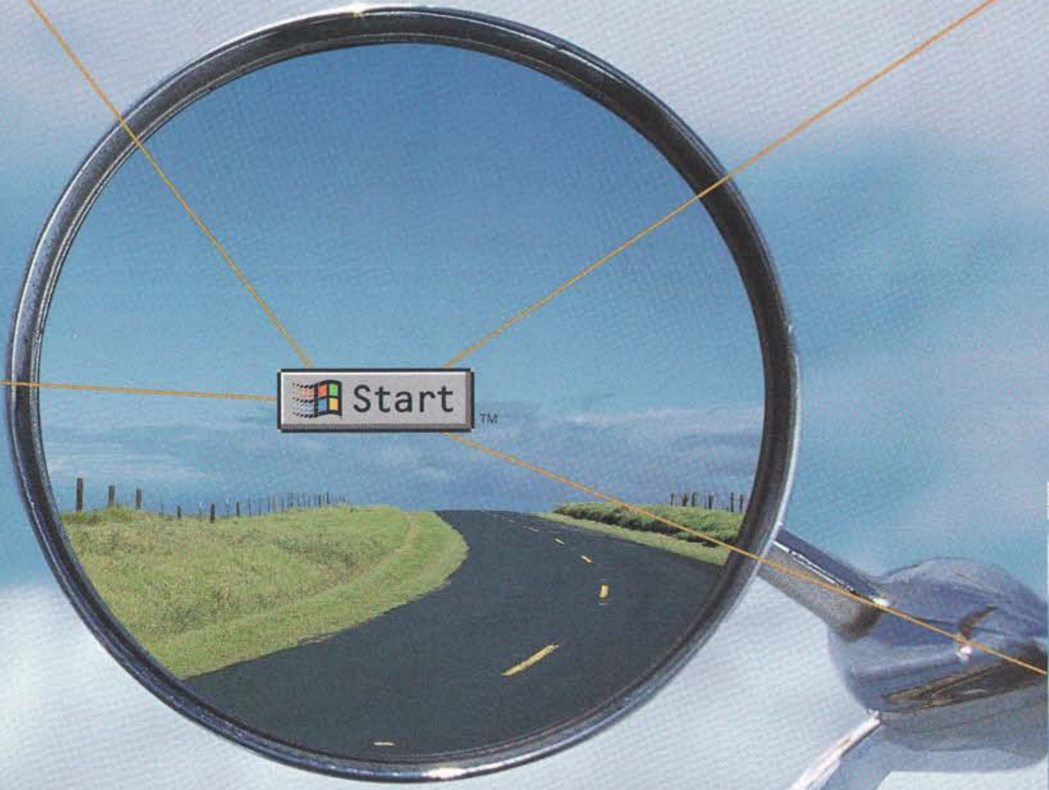

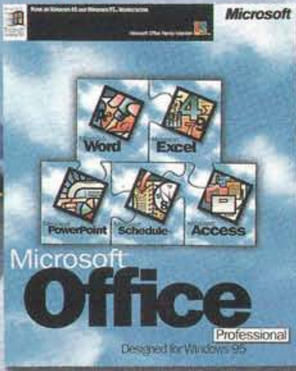

Now you can take full advantage of Windows 95.

New Microsoft Office was designed to work hand-in-hand with the Windows® 95 operating system and its simplified user interface. To make the most of 32-bit performance, long filenames, shortcuts, multitasking, and the Windows Explorer. Together, they make computing fundamentally easier and faster. They make it possible for you to spend less time computing, more time working effectively.

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OCTOBER 1995 VOL. 20, NO. 10

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How do you build an algorithm that is both generic and efficient?

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BY STEPHEN COBB

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building real-time error checking into their compilers.

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We Plugged, but They Didn't All Play 36

Tests of several new Plug and Play devices show that unless you have all the required pieces in your system, you can expect to do a lot of work.

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A new era in broadcasting begins on the Internet.

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3-D Images That Float in Air 48

A new system can project images from a PC so that they appear to be solid objects suspended in air.

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Jerry witnesses several test flights: First the DC/X spacecraft, and then a new Pentium, a new hard drive, and several builds of Windows 95.

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BYTE Contents by Platform

This page presents the articles in this issue according to computing platform.

DOS/WINDOWS

Intel's Rivals Ready to Exploit P6 Weakness 26
Further tests confirm what we reported last month: If you're running mainly 16-bit DOS and Windows applications, don't rush out to buy a P6 PC. Or maybe you should consider AMD's K5 or Cyrix's M1.

Coming: A Better Multimedia Platform 27
Windows 95 has several technology components, such as 32-bit video codecs, designed to make it a better foundation for multimedia. But some other significant pieces are missing.

New Replication Options in Access, Oracle, and Notes...... 30
Database programs get a feature that will be a big hit among developers supporting remote workers.

Run-Time Error Checking Comes to Compilers 34
New development packages from Borland, Microsoft, and Nu-Mega should help Windows programmers check their code.

We Plugged, but They Didn't All Play 36
We test a bunch of alleged Plug and Play devices and find that you often have to do some work before you get to play. Somehow it's not surprising.

Face to Face 69
This explanation of the H.32x standard also looks at some Windows products for videoconferencing.

A Data Miner's Tools 91
Forget the pick and shovel. Here are programs that can help you sift through mountains of data and separate the nuggets from the slag.

Windows 95: The Numbers 113
BYTE tests shipping Windows 95 code against Windows for Workgroups 3.11, revealing the performance limitations of Microsoft's new OS.

Applications 95 Arrive 117
Enterprises might not rush to deploy a new desktop interface, but they will move to Windows 95 for the powerful new applications it enables. Here's a review of some of the best so far.

Au Revoir, Mon Ami 127
Lotus's new version of Ami Pro—now called Word Pro—has some innovative additions, especially for workgroups.

Digital Cameras for Real Work 129
Affordable digital cameras—priced under $1000—from Apple, Kodak, and Logitech are good for business, scientific, and publishing applications.

Weaving a Thread 173
Borrowing from the ideas of object-oriented programming, Windows NT was designed from the ground up to support multiprocessing and multithreading.

Pournelle: Death Swoops and Upgrades 181
In a month of big upgrades, Dr. Pournelle installs the latest version of Win 95 and—guess what?—runs into a few problems.

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Whatever Happened to . . . ? ... 34
In which we report on the whereabouts of OS/2 for the PowerPC.

Code Talk: A New Age for OS/2 Programmers 46
Rick Grehan works with the latest version of IBM's Visual Age C++ development environment for OS/2. It combines visual programming tools with a compiler.

Pournelle: Death Swoops and Upgrades 181
It's upgrade time at Chaos Manor. Jerry installs OS/2 Warp Connect. Despite "one major design defect," he finds it "solid as a rock."

MACINTOSH

Options Increase, Prices Drop for Mac Add-Ons 40
If you've got a PCI Macintosh, you're going to have a big selection of graphics accelerators. Card kings of the PC realm (ATI, Matrox, miro, and others) are bringing their products to the new-bus Macs.

Face to Face 69
Videoconferencing gets a compatibility kick from the H.32x standard. QuickTime Videoconferencing and other products bring H.32x support to the Mac.

A Data Miner's Tools 91
Specialized software for digging valuable information out of mountains of stuff.

Power Mac Gets PCI 123
If you were getting delirious and thinking you needed a Pentium, stop right now and read this review. The PCI-based Power Mac 9500 is the new Apple dream machine.

Digital Cameras for Real Work 129
Apple's QuickTake 150 digital camera offers improved resolution and image processing. Similar cameras from Kodak and Logitech provide higher resolution for printed images and have Mac software, too.

Apple's Dynamic Duo 160
The PowerBook Duo 2300, with its PowerPC 603 CPU, provides RISC performance and long battery life. It's a welcome addition to anyone's briefcase.

UNIX

Weaving a Thread 173
The two-tier thread library in Sun's Solaris lets applications developers take advantage of multiprocessing and multithreading.

NETWORKS

New Replication Options in Access, Oracle, and Notes...... 30
Databases make it easier for mobile and remote workers to be in sync with the home office.

We Plugged, but They Didn't All Play 36
We test some allegedly Plug and Play products—including some network cards—with Windows 95.

The New PC 52
Personal computers of the next two to five years will be better equipped for networking, with connectivity built into the hardware and the OS.

Face to Face 69
Getting one videoconferencing system to work with another is going to be less of a sticky wicket, thanks to an international standard called H.32x.

Data-Mining Dynamite 97
One of the best ways to capitalize on an enterprise's information is to build a data warehouse, a server-based replication of a mainframe's data. When users need information, they send a query to the warehouse.

BOMB's Away 105
Web technology isn't just a way to publish electronic documents. It's also a way to build networked applications that work within and beyond corporate boundaries.

Applications 95 Arrive 117
Visual Voice for Win32 is one of the killer applications for Windows 95. This 32-bit OLE implementation provides developers with tools to build telephony-based applications.

Internet Firewalls 179
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Pournelle: Death Swoops and Upgrades 181
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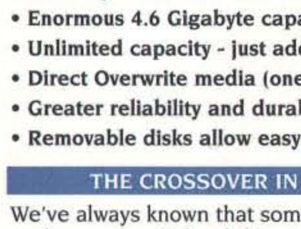

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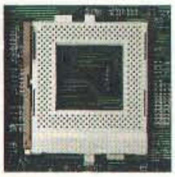

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"Green" features	Yes	Yes	Yes	Yes
Plug & Play	Yes	Yes	Yes	Yes
RAM (MB) /Cache (KB)	8/256	8/256	8/256	8/256

7 Environmental care.

Respect for the environment has always been a priority in Olivetti's choices.
For this reason, Modulo - like all Olivetti PCs - is produced with 77% recyclable materials. But ecology also means energy saving: in accordance with Energy Star mark the Power Management System permits considerable energy savings when the PC is switched on but unattended.

8 Three-level security.

When it comes to security and data secrecy, Modulo PCs are second to none. With numerous options on three levels (hardware, software and mechanical), all data and applications - of prime importance to a company's life today- can be accessed only by authorized persons.

Three security levels : hardware, software and mechanical. This is how Modulo PCs store data in maximum security and secrecy.

9 ISO 9241 and CE : full conformity.

Olivetti has maximum respect for the requirements and safety of users. A tangible example of Olivetti's full conformity with the European ISO 9241 standards is in the monitors with their high image-stability and low radiation emissions.
Or in the casing and the keyboards, designed according to the most advanced ergonomic criteria.
In addition, the CE brand guarantees the absolute conformity of Olivetti PCs to the European safety and EMI (Electro Magnetic Interference) compatibility standards.

10 Customer care: 15,000 specialists.

Choosing Modulo, or any other Olivetti PC, means choosing an international network of 5,500 Dealers and System Partners and 15,000 specialists to provide companies with all the assistance, support and advice they need. Just one more reason, besides the above, for relying on Olivetti. And for counting to ten before choosing any other PC.

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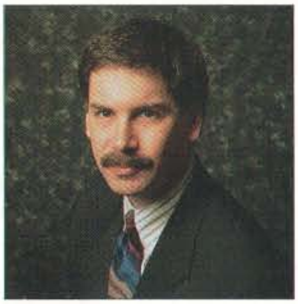
I Can See What You Mean



New products and services will free us from the shackles of old technology. First to fall: the PC's AT architecture.

From the home office I've set up in my Boston apartment, I have a clear view across the Charles River to MIT. Sometimes when I'm editing a BYTE story about far-future technology, I look up from my desk and wonder just what is going on in the MIT Media Lab, what strange future they're assembling over there.

But it turns out that with the right software, I can see what they're doing. Literally. MIT, along with dozens of other institutions and businesses, runs a number of Web-accessible spy cameras (or just *cams* in the vernacular). There's even a guy over there, Steve Mann, who has mounted a wireless video camera on a helmet. Jump to his page (http://www white.media.mit.edu/~steve/netcam.html) and you can see what he sees.

Mann, in fact, has a troop of friends with headcams. You think the scariest moment in a businessperson's life is when Dan Rather and the *60 Minutes* crew knocks on the door? Try to imagine how you'd feel if six people wearing head-mounted video cameras showed up in your office.

Among the mad-scientist community of computer engineers, it's an accepted notion that wearable computers and their I/O devices are just around the bend. And it's also accepted that, not far behind them, is the generation of users who will come to accept implanted computer technology.

As Marc Demarest, director of strategic marketing for Sequent Computer Systems, says, "The computer wants inside your head." He expounds the frightening point of view that technological evolution is opportunistic, like the evolution of parasites. The devices seek hosts. And he doesn't mean Sequent superminicomputers. He means a living, breathing class of host, who will come to depend on technology the way we now depend on the bacteria in our digestive system.

His evidence: Computers are getting closer to us and our personalities. We can now get affordable virtual-reality goggles that put SVGA monitors 2 inches from our eyeballs. And there is a whole industry growing up around designer mouse pads, screen borders, and even color-coordinated computers—all of which are designed to make us more comfortable with the technology. But technology would be even more "in our head," Demarest says, if software user interfaces were less adversarial and more visceral, as they are in good video games, which present enormous amounts of information—graphical, intuitively—and put the player in a "tight loop" of information and response.

If the concept of computer evolution matching biological evolution is a little too far out for you to grapple with right now, at least you can agree with me that the computer wants inside your wallet. When we began doing this month's Cover Story, "The New PC," I called Ted Selker, IBM's manager of its user systems ergonomics research division. Selker designed the IBM TrackPoint eraserhead pointing device, not to mention the Butterfly keyboard on the ThinkPad 501C. I asked him what leading-edge machines he had floating around in his lab that he could send us for the story. He said, "Give me two days. I'll build you a wallet computer."

The wallet computer didn't make it into this issue (too far out even for us), but several other new technologies did, including those embodied in the machines on this month's cover. Illustrating the latest trends in dockable portables is IBM's Leapfrog (the squarish machine with the confusing case). Apple shows its vision of portable technology migrated to the desktop (check out the screen and keyboard), and Archistrat has a line of computers based on a new bus architecture.

None of these machines use the ancient architectures of the PC—ISA cards and slow serial ports, for example. We think that's great. The old architecture has been with us for too long and is hobbling our steps into the future. These new machines are the platforms for the future. We'll be seeing new architectures on our desks soon, just as you may soon be seeing wearable webcams in your office lobby. ■

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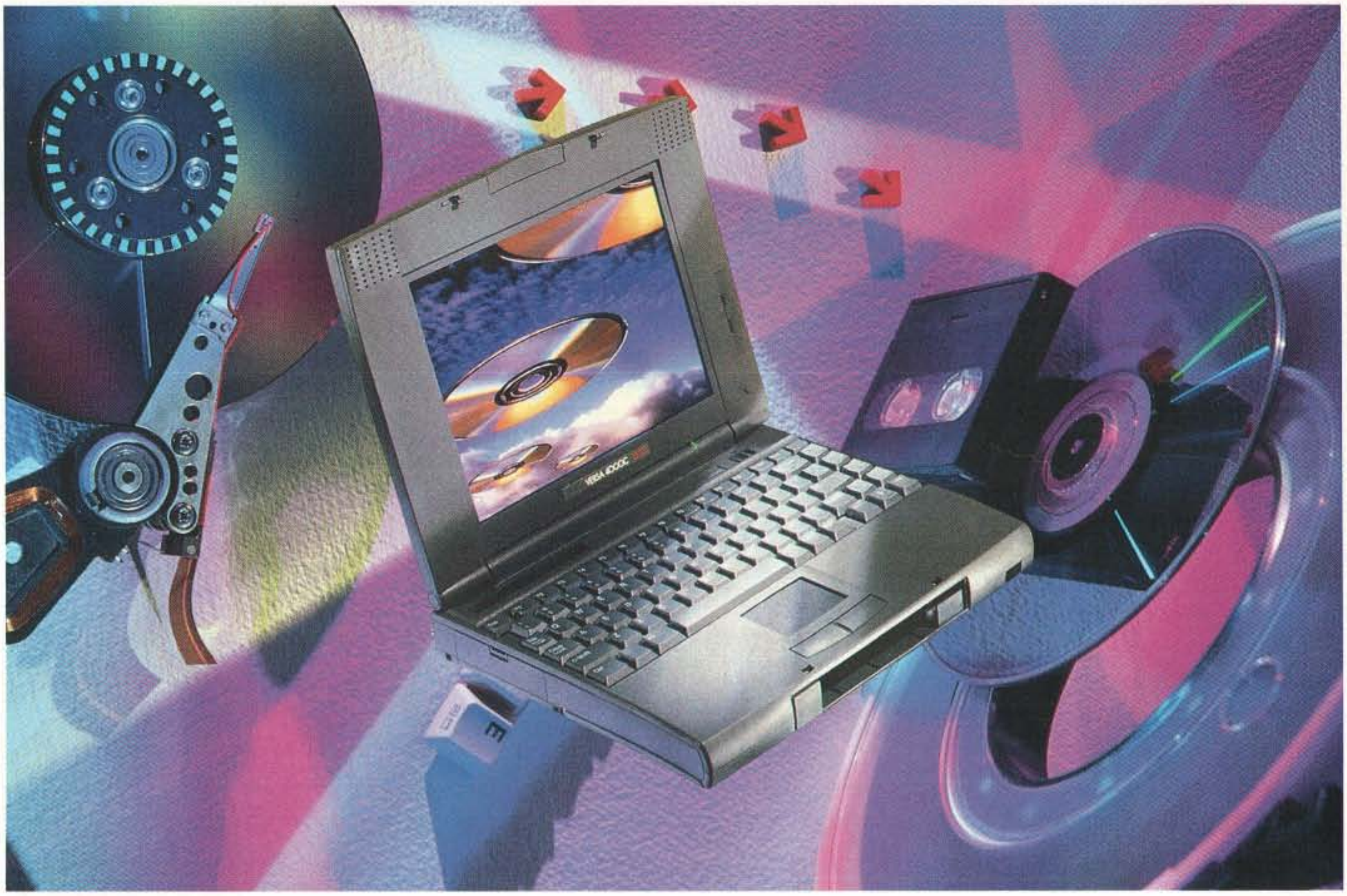

NEC VERSA® 4000: THE MOST INNOVATIVE MULTIMEDIA NOTEBOOK

There are three keys to the superior performance of the VERSA 4000: super-fast Pentium® processing, unmatched modularity, and advanced multimedia functionality. The core of the system is a 90MHz or 75MHz Pentium processor, with the latest energy-saving technology.

Its extraordinary versatility comes from the innovative VersaBay™ II. This front-loading slot lets users customize the notebook by slipping in their choice of modules: a CD-ROM drive, floppy drive, second lithium ion battery or second hard drive.

Versa's multimedia capabilities fully meet the needs of today's mobile professionals. With a choice of large 10-plus inch TFT color screens, with resolutions up to 800 x 600, the VERSA 4000 can display presentations in up to 16.8-million colors. Other multimedia features include two stereo speakers, microphone, Sound Blaster® Pro-compatible stereo sound system, four audio ports, volume-control dial and full-motion video support.

The VERSA 4000 also has two PC Card slots and complete desktop-docking capabilities. Two infrared ports support printing and file transfer. Users can expand the standard 8MB memory up to 40MB: 540MB/810MB disk storage up to 1GB. Pre-installed software includes Windows® 95.

C&C for Human Potential

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"Connect!"

TELECOM 95
GENEVA 3-11 OCTOBER 1995

Updates on the scope and depth of NEC technologies

Number 157

DIGITAL INTERACTIVE SERVICES VIA COPPER PAIR

Telstra of Australia is implementing a pilot program to deliver interactive video services over existing telephone copper pair cables to 300 subscribers in Melbourne. The enabling technology is called ADSL, Asymmetric Digital Subscriber Line technology.

As prime contractor for the project, NEC Australia is responsible for system design, equipment supply and overall integration. Key equipment includes video servers, MPEG encoders, switches, ADSL line cards, and set-top boxes.

The pilot program will use two types of ADSL transceivers: 2Mbps Carrierless Amplitude Phase units and 6Mbps Discrete Multi-Tone units. The system will deliver live and stored video programs to support both Pay-per-View and Video-on-Demand services.

The system architecture is among the world's most advanced in terms of scalability and openness to future enhancements. It accommodates both new subscribers and multiple video information providers.

The system can be upgraded to provide a wide range of interactive multimedia services. They include home shopping, travel services, directories, databases, video games and instructional/educational programs.

NEW ENTERPRISE ATM SWITCHES

Many enterprises are enhancing communications with LANs based on ATM technology. To meet diverse user needs, NEC has expanded its lineup with two new enterprise ATM switches, ATOMIS 5E and ATOMIS 7E.

ATOMIS 5E features throughput of 2.5Gbps. It supports interfaces of OC-3/STM-1, TAXI, DS3, E3, and 6.3Mbps. ATOMIS 7E offers maximum throughput of 10Gbps. It further supports OC-12/STM-4. To maximize network reliability, ATOMIS 7E features redundant switches and controllers.

Both enterprise switches support a full SNMP agent. This enables integrated network management of LAN equipment such as routers and hubs. Both switches comply with ITU-T, ATM Forum and other international standards.

NEC has also introduced ATOMVIEW, a sophisticated system for integrated management of ATM networks. ATOMVIEW automatically recognizes network structure and collects traffic data. Its graphical display simplifies maintenance and control operations. ATOMVIEW complies with the latest ATM Forum standard for Call Admission Control.

ATOMIS 7E

ATOMIS 5E

NON-LINEAR MO EDITING SYSTEM

Tapeless, non-linear program editing is a major advance in TV broadcast technology. NEC has introduced a smart, simple, PC-based system that allows users to take advantage of the vast capacity of magneto-optical (MO) disks.

Our non-linear editing system centers around a compact MO video disk recorder and a 23-GByte MO disk. The 30cm disk records 32 minutes of uncompressed NTSC video and audio, or 38 minutes of PAL video and audio.

The VF-200 MO video disk recorder offers many advantages. Real random access allows you to select start-points, end-points and sequencing at will. You can edit and transmit during recording. It permits separate editing of high-quality video/audio and still/slow playback. You can remove disk cartridges for permanent storage.

NEC's non-linear MO editing system is a versatile performer, designed for on-line news and sports as well as off-line applications.

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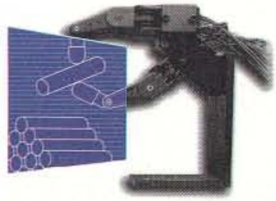

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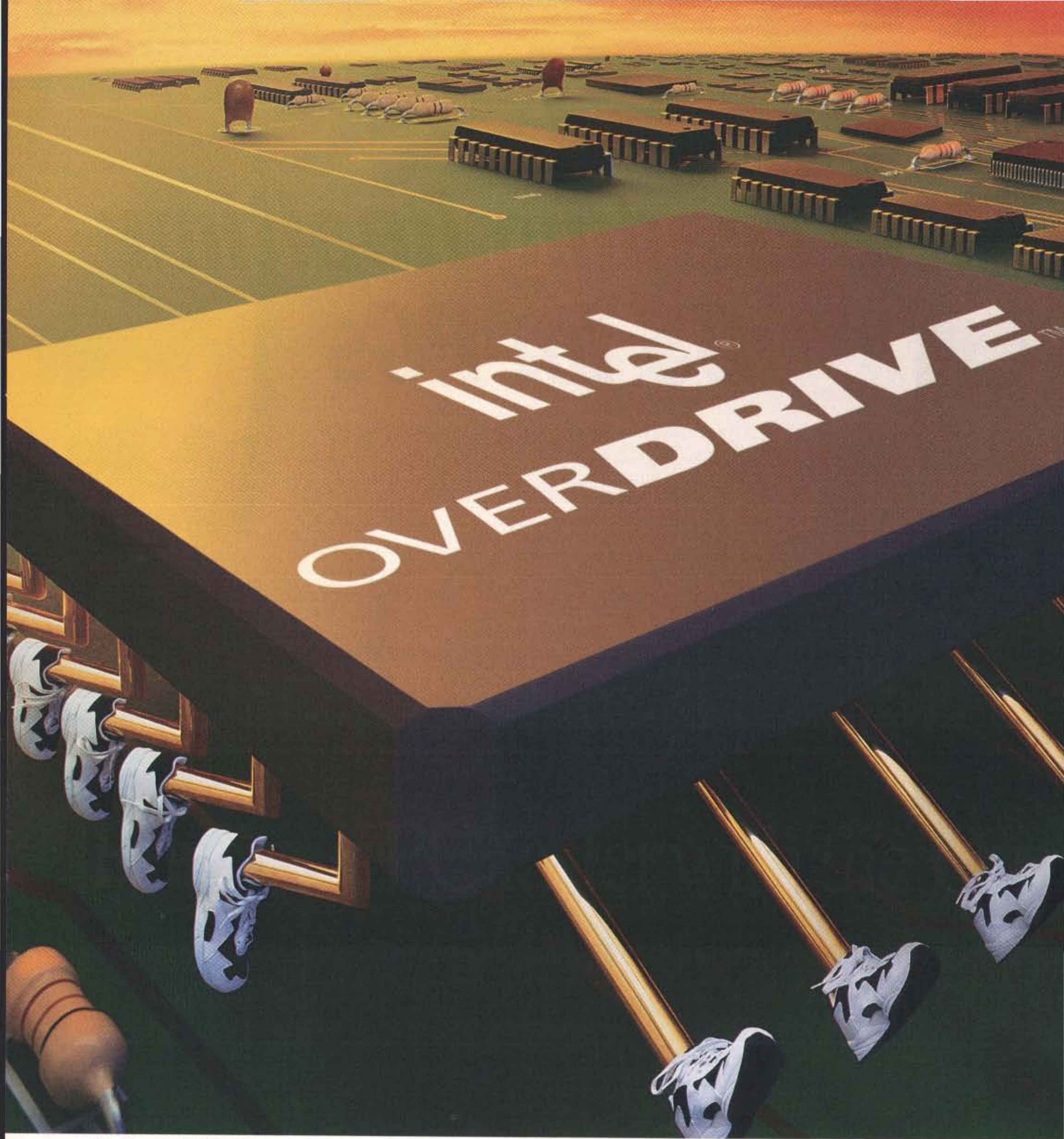
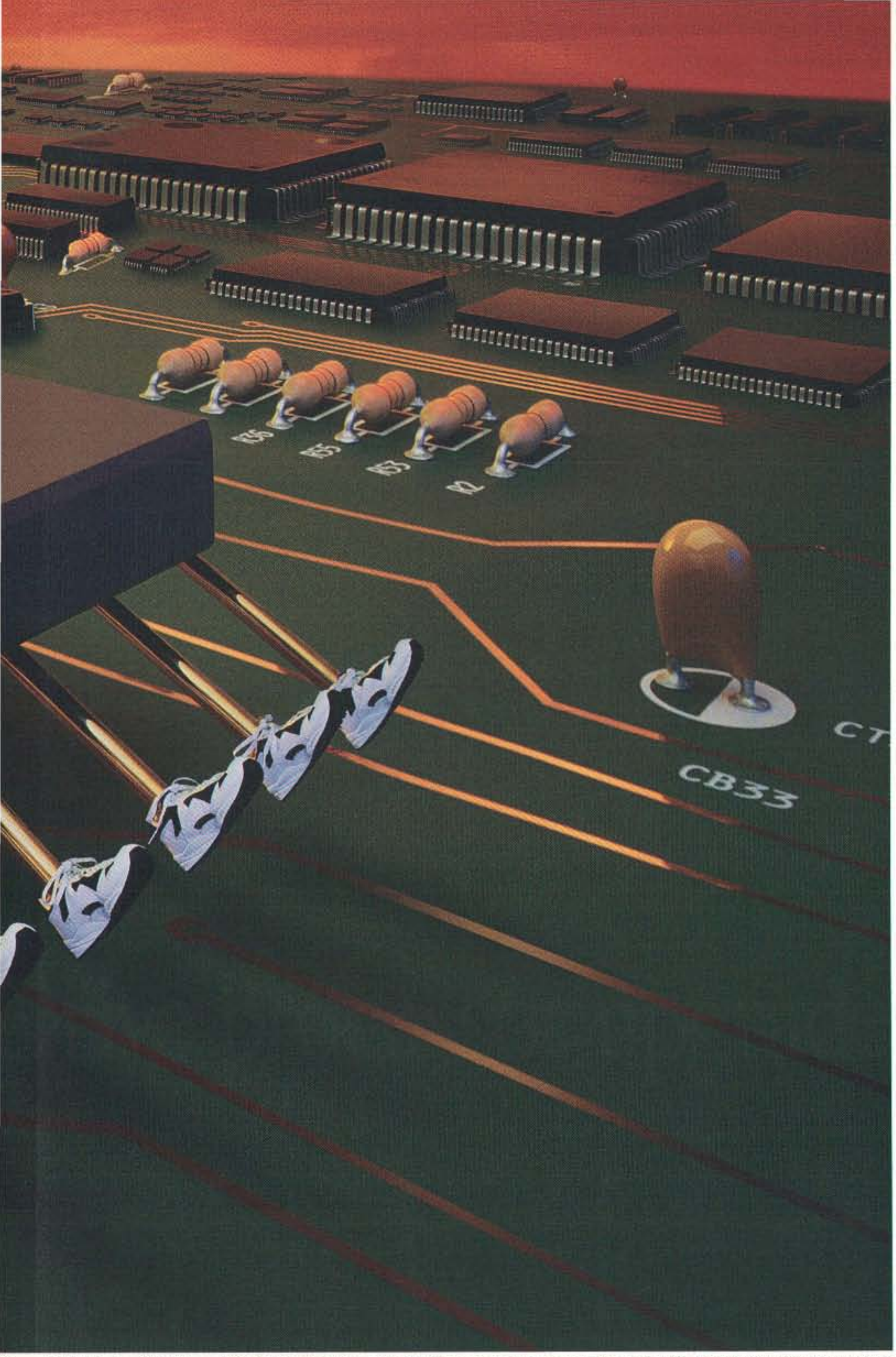


©1995 Intel Corporation. †The 63-MHz Pentium OverDrive processor for most 50-MHz and 25-MHz Intel486 CPU-based systems is available now. The 83-MHz Pentium OverDrive processor for most 66-MHz and 33-MHz Intel486 CPU-based sys
ratings are for processors running in write-back mode. i486™ processor-based systems supporting the write-through mode will yield approximately 15% lower iCOMP index ratings when upgraded with the Pentium OverDrive processor. *Other trade n

Run your PC faster with the Over



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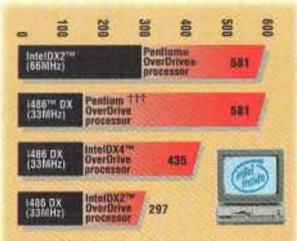

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ill be available in September, 1995. ††Source: iCOMP®: A Simplified Measure Of Relative Microprocessor Performance. Intel Corporation, 1992. †††Pentium OverDrive processor iCOMP
eferenced are the property of their respective holders.

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The Inelegant Kludge

I'm a bit confused by your article on Windows 95, "The Elegant Kludge" (August). The title and first two paragraphs seem to set the tone: Windows 95 is still "just" Windows. The "Windows 95: Head-to-Head" matrix (page 54) clearly shows that OS/2 Warp Connect is the superior choice. Then after lots of words describing the architecture of Windows 95, you conclude that I still should buy it because it has a slick user interface. Or worse yet, if I want a "real" 32-bit operating system, I should consider Windows NT. If Windows 95 is half-baked, why should I believe that the same cook didn't forget something in the baking of Windows NT as well? I'm not sure if it was the author's intention, but I think OS/2 Warp may be worth looking at now.

Doug Carter
dougc@clam.com

Telling It Like It Is

Bravo! Your August cover story delivered the first honest and complete coverage of what Windows 95 is and isn't. Win 95 is an important stepping stone to the next (real) operating system for Intel-based PCs. I picked up an extra copy of the issue to distribute around the office (I want to keep mine in one piece).

Dick Womack
Senior finance systems support analyst
Pepperdine University
dwomack@pepperdine.edu

Why Did Win 95 Win?

In your News & Views story "Network and Windows 95 Take Top BYTE Awards" (July), you state that the editors voted Windows 95 as the Best Operating System and the Best of Show because "This was the first Comdex at which Windows 95 was in full display on the show floor." I was under the impression that BYTE gives something the Best of Show prize at Comdex because of its outstanding quality and usability, not because its manufacturer plasters it everywhere, forcing others to follow or go out of business. This is nearly as sad as seeing BYTE's Web server use 8.3 filenames.

Szabolcs Szigeti
pink@fsz.bme.hu

Windows 95 is not perfect, but it is a pretty good step toward dragging the huge Windows installed base into a 32-bit future. And some of the 32-bit apps that Win 95 enables will be powerful, innovative, and just plain neat.—Eds.

OS/2 or Not OS/2

I have been a BYTE subscriber for years, but I was upset with the August issue. Of the three articles listed in the Contents by Platform index as OS/2 articles, two were actually about Windows 95 and one was about Lotus Notes. The shift in your editorial stance to ignore a major operating system has led me to feel deserted by BYTE. I realize that you have to cover Windows 95, as it is "hot" news. But to disguise those articles as OS/2 articles is insulting to those of us who use OS/2 and have no plans to change to Windows 95.

Steve Shultz
72073.1673@compuserve.com

Blasts in the Past

In the August issue, "The Last Blasts Quiz" seems to imply that there will not be any more Blasts from the Past page. That would be very disappointing. I think the Blasts column is one of the most valuable in BYTE, and I hope it can continue. It gives us a perspective on what everyone used to think was the latest thing.

Duke Briscoe
duke@harlequin.com

Blasts from the Past was a special column to help us and our readers prepare for our 20th anniversary issue, which we published last month.—Eds.

GNU Is Gnot Gnarly

In his Code Talk column entitled "ANSI C Anywhere" (June), Rick Grehan wrote of how difficult it is to port the GNU C/C++ compiler and how easy it is to create a new C compiler using a different set of tools. GNU C/C++ is just like those other tools, requiring a target machine file and machine description file. I was able to have a bug-free GNU compiler for the Hitachi-HD16 processor in four days. And the GNU C/C++ outperforms most optimizing compilers.

Kerwin F. Medina
via e-mail

I personally found the GNU documentation difficult to follow. It could have improved since I saw it; it could also be that I simply didn't have the mental horsepower necessary. In any case, I am happy to hear that you had such an easy time of it. I applaud the entire concept behind GNU products.

—Rick Grehan, senior technical editor
rick_g@bix.com

Unfriendly Reader Interface

I don't mean to be a Luddite, but I hope the new background/foreground color schemes you used in your cover story "Inside the Mind of Microsoft" (August) are not a harbinger of future BYTE graphics. The dark-shaded text boxes were very hard to read except in perfect lighting conditions. Are you attempting to emulate certain newly arrived cyberzines? If so, please reconsider!

Jim Wheelock
New York, NY

Agreed. In the future, we will try to make our articles easier to read.—Eds.

Totally RAD, Dude

I found "The End of Programming" (August) very helpful. Having just taken a PowerBuilder class (but not having built anything with it yet), your warnings and suggestions are well-taken advice regarding how to best use the RAD (rapid application development) technology. I plan to keep a copy of your article with my manuals.

Mike McIntosh
Mike_McIntosh@sysprog-ada.ccmail.compuserve.com

We want to hear from you. *Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458; or you can send E-mail via the Internet or BIX to editors@bix.com. Letters may be edited.*

LOOKING FOR A SIMULATION SYSTEM THAT HAS IT ALL?

"It is with great satisfaction that I can recommend Taylor II to potential users of simulation software. We have recently purchased this excellent package and believe it to be a powerful productivity tool for the industrial engineer. The package features are superb, and the entry price for the software is reasonable. We look forward to many years of benefit from this package: Taylor II is a major development for industrial engineers. The package is good, the support service and the training courses are first class. Taylor II is simply the best."

Jim O'Neill
Industrial Engineering Manager
Waterford Crystal Limited, Ireland

"There is only one thing I regret about owning Taylor II: I wish I had owned it sooner."

G. Molloy
Conner Peripherals
USA

"The product is as pragmatical as the service, which makes Taylor II an excellent business tool."

T. Veltman
KLM Royal Dutch Airlines

"In our search for a simulation software, we found Taylor II to be the most complete package at the best price. The sales person presented us with an inhouse demonstration that was far more interesting and informative than any of the others given to us. Most importantly, their customer service clinched the sale. Their technical support, users conferences and newsletters are all superior to those of their competitors!"

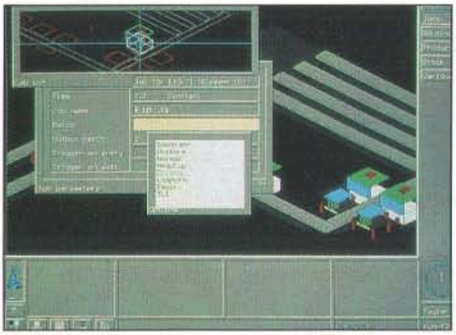
Edward Nisbet,
Senior Industrial Engineer
Philips Consumer Electronics

BEST OF BYTE CeBIT'95

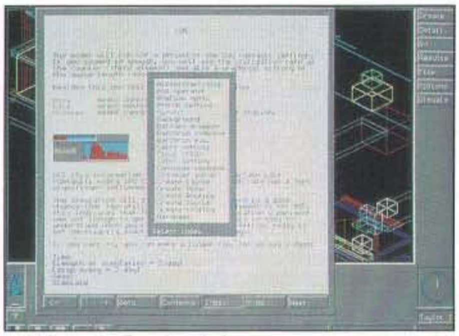
WINNER

At this year's Cebit, the editors of Byte Magazine awarded Taylor II as 'Best application software of Cebit 1995'.

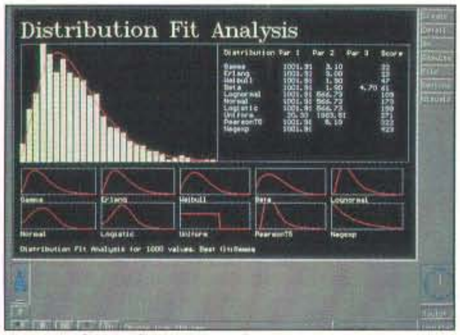
I'VE GOT WHAT YOU'RE LOOKING FOR...



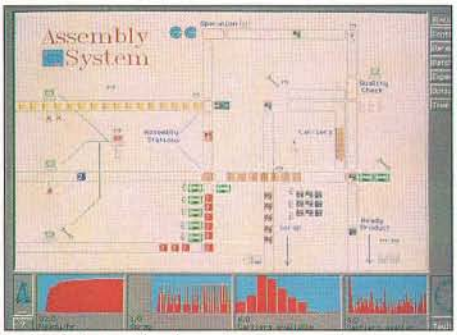
Taylor II offers pop-up menu modeling and editing...



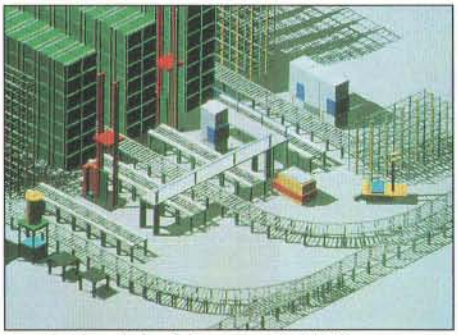
...500 pages of on-line help...


Distribution Fit Analysis
Gamma
Erlang
Weibull
Beta
Lognormal
Normal
Logistic
Uniform
PearsonT5
Distribution Fit Analysis for 1000 values. Best fit:Gamma

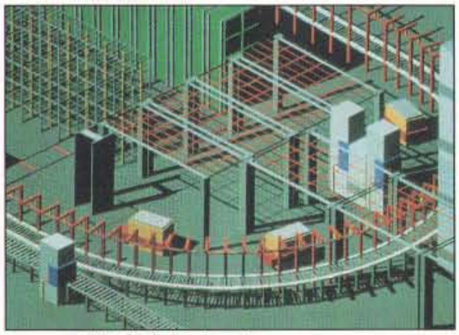
...curve-fitting for input analysis...



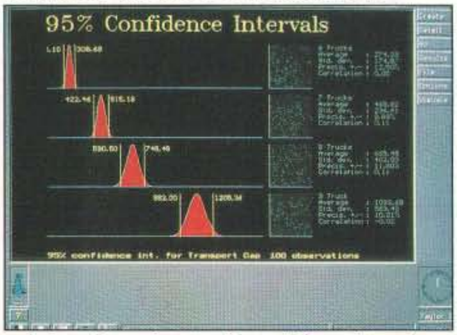
...simulation with schematic 2D animation...



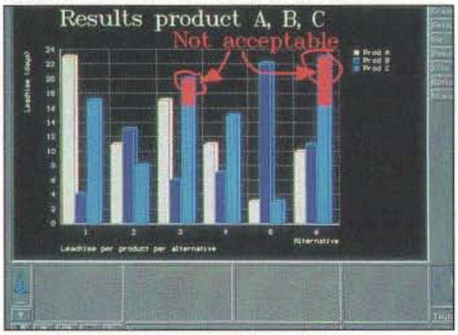
...or (with a click of the mouse) 2 1/2 D...



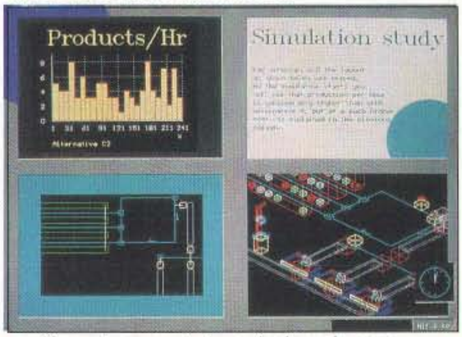
...or true 3D shaded animations...



...design of experiments with confidence intervals...



...result analysis in reports and graphs...



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Circle 531 on Inquiry Card.

Slight Misunderstanding

There is a small error in Tom Thompson's feature story "Apple's New Operating System" (June). He asserts that Copland's hardware abstraction layer is "a feature currently found only in Windows NT." In actual fact, IBM's OS/400 and its predecessor S/38 CPF have been based on a HAL since the first S/38 was introduced in the early 1980s.

David Welden
Newport Beach, CA

Our article was describing a new desktop OS, so we were comparing it with other desktop OSes. Just as NT and Copland will probably not appear on an AS/400, OS/400 is not going to be running on a PowerPC or Intel desktop machine anytime soon.
—Tom Thompson, senior technical editor, tom_thompson@bix.com

Make the Senders Pay

I agree with Nick Baran's Commentary ("Stop, Look, and Listen!," August). Billions of dollars are going to be wasted as companies try to launch poorly considered information services. Forget the notion that people will pay to receive information. Look instead at industry models where senders carry the brunt of the costs, such as advertising-driven media like TV and radio broadcasting or newspaper and magazine publishing. We need new industry models that support distribution of digital information from paying senders. Invest those billions of dollars, but in services that we as customers want and can afford.

Peter Ruhe
peterr@wimsey.com

Lighten Up on Microsoft

I was very impressed by Rafe Needleman's editorial on Microsoft ("Why I Love/Hate Microsoft," August). I have always felt that those who bashed Microsoft for the way it does business were simply suffering sour grapes. They were upset at the fact that they didn't market their products or ideas as well as Microsoft does.

Gerry O'Brien
Moncton, New Brunswick, Canada
gerryobr@nbnet.nb.ca

I am amused by the resentment and furor emanating from Microsoft bashers. In your recent editorial, I sense that you dislike the company when you use phrases such as "Evil Beast" and "corporate arrogance." If Microsoft does not understand the corporate market, it can hardly be called arrogant. Ignorant, perhaps, but not arrogant. Windows is not perfect, but neither is anything else created by human beings. Show me a DOS, Mac, or OS/2 user who never had to reboot his or her computer and I will show you a bridge for sale.

Gary Wong
Oakland, CA

Amiga Redux

I was surprised to see an article essentially devoted to LightWave3D ("Desktop Hollywood F/X," July). I guess this is because it is now available for real personal computers (sarcasm intended) and not some obscure toy like the Amiga, which was four to five years ahead of its time. In your list of company addresses, you included Commodore Business Machines, but Commodore has been out of business for over a year now. The Amiga is now owned by Amiga Technologies GmbH, a part of Escom AG.

Zoltan Hunt
Downsview, Ontario
am609@freenet.toronto.on.ca

Amiga fans, rejoice! German company Escom AG has acquired Commodore Electronics Ltd. and Commodore's Amiga technology. Escom's plans reportedly include producing the Amiga 600, 1200, and 4000 series and melding Amiga and MS-DOS systems. Here's the contact info: Escom AG, Tiergarten Strasse 9, Heppenheim, Germany 64646; +49 6252 7090; fax +49 6252 709 442.
—Ed DeJesus, senior editor
edejesus@bix.com

GSM Is Not MSG Backward

It was nice to read your "Special Report on Mobile Computing" (June). As a reader living outside the United States, I noticed that there was no mention of GSM, the global system for mobile communications. I have heard rumors that some GSM operators will start soon in the U.S. It would be nice to read about it and how companies are using it. GSM provides 9600-bps connections, which are not the most efficient, but better speeds are coming.

Jan Laakso
jan.laakso@cc.tut.fi

GSM is very popular in Europe. Unfortunately, I leave my mobile phone here when I travel abroad because the standards are different. I would gladly trade my phone for a GSM unit if I could get GSM services in the U.S.
—Rafe Needleman

FIX

Due to an editing error, our article "The Elegant Kludge" contains a mislabeled diagram describing OS/2 Warp's memory model (August, page 56). The two boxes labeled VxD should be labeled VDD. We regret the error. ■

COMING UP IN NOVEMBER

- **ENTERPRISE DATABASES**
  We look at industrial-strength databases for the desktop: Oracle for OS/2, DB/2 for OS/2, and Microsoft SQL Server for Windows NT.
- **ZAPPED!**
  We report on our tests of uninterruptible power supplies (UPSes) that not only provide the juice but can communicate with your PC for controlled shutdown.
- **WORKSTATIONS**
  More reviews of Windows NT workstations, including an Alpha 21164 and a new crop of PowerPC systems.
- **LET YOUR NETWORK DO THE WALKING**
  Directory Services help bring ever-larger and complex networks under control.
- **SIMULATING BUSINESS**
  How Siemens Solar Industries has made extensive use of simulations as part of its effort to reengineer business processes.

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You've evolved. You've got Microsoft® Windows® 95*. But don't stop there. Move up to the revolutionary multimedia Win 95 products from Creative Labs. You'll get next generation performance, plus radical ease of installation.

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Olivetti ink-jet printers.

Before choosing any other printer, count to ten.

1 The best of Olivetti 's know-how.

Olivetti is Europe's biggest manufacturer of ink-jet printers. Its products are the result of 20 years' experience and research in this sector and all of Olivetti's plants and production processes have received ISO 9001 total-quality certification.

2 JP 450: productivity and flexibility.

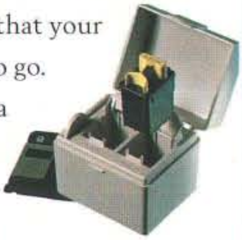
The JP 450 is the fastest printer of its kind. It prints up to 5 pages a minute and can reach a virtual resolution of 600 x 300 dpi in text mode - perfect print quality. Silent and powerful, it can be equipped with numerous options such as a 2nd sheet-feeder, a sprocket for continuous stationery or a special feeder for envelopes and transparencies, making it a highly flexible tool even for automatic mailing. And the JP 450 is already preset to give you excellent colour prints.

3 JP 360: the best at a low price.

Also preset for colour printing, the JP 360 offers the best price/performance ratio. In fact, it gives you the same print quality as the JP 450 - both in black and white and in colour - using the same print heads. It can print up to 3 pages a minute and takes up a minimum of space.

4 The best colour when you need it.

The optional colour kit for the JP 450 and JP 360 opens the door to high-quality printing.
You decide when you want to use colour, knowing that your printer is ready to go.
The kit contains a manual with lots of tips on creating the best colour documents, plus the powerful Olichrome driver for hi-fi chromatics.



5 JP 50: portable technology.

The JP 50 concentrates desktop performance into 1100 g. and 30x13x6 cm. It works when and where you want it to, running either off the mains via the standard power adapter (which doubles as a battery charger), on regular or optional rechargeable batteries - providing 80 to 140 page autonomy - or on the optional car adapter cable. Although it's the smallest and lightest portable ink-jet printer, the JP 50 offers 300 dpi resolution, prints 1.7 pages a minute and has a built-in ASF.

6 Low running cost.

All of Olivetti's ink-jet printers use a patented refill system that allows a significant cost per page reduction compared with traditional ink-jet printers. The actual print head can be reused several times - only the ink cartridge is changed. All models automatically signal when the refill is running out so that the head doesn't run dry, protecting it from possible damage. They also give you economy or draft print choices that save about 50% on ink. All this at energy consumption 20 times lower than a laser.

7 Fonts for free expression.

Olivetti ink-jet printers give you the utmost freedom of expression, thanks to their wide range of fonts - 30 resident and 25 scalable True Type fonts for Windows.

8 Total compatibility.

Every feature of the Olivetti ink-jet printers, even the most exclusive, is immediately available thanks to a range of drivers loaded on the disk that comes with the printer. Designed and certified by Olivetti, the drivers are tested and approved by the biggest international software producers to guarantee their full compatibility and optimum performance. In the package you'll find drivers for Windows and the most popular DOS programs, while those for more specific needs (such as Windows NT and OS/2) are available on request.

Technical Features	JP 450	JP 360	JP 50
Ink-Jet Refilling System	Yes	Yes	Yes
Color Kit	Yes	Yes	-
Max resolution (dpi)	600x300	300	300
Max speed (cps)	400	180	100
ASF capacity	150	70	15
cps in LQ mode	160	120	100
TrueType scalable fonts	25	25	25
Resident fonts	30	30	30
Page per min. (max)	5	3	1.7
Expansion slot	1	1	-

9 Ergonomic design.

In the Olivetti tradition, design is always in the forefront. The softly rounded, exclusive and attractive shapes of these printers are the result of rigorous, ergonomic research to guarantee their easy, safe and dependable use.

10 Customer care: 15,000 specialists.

Those selecting Olivetti JP printers find an international network of 5,500 Dealers and Systems Partners and 15,000 specialists to provide companies with all of the assistance, support and advice they need. This, like the others listed above, is only one of the many reasons for relying on Olivetti. And for counting to ten before choosing any other printer.

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France (1) 49067000
Germany (69) 66922755
Greece (1) 9373800 - Holland (71) 319931
Israel (3) 7516879 - Italy (167) 012587
Norway (22) 186100 - Portugal (1) 3558260
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NEWS & VIEWS

X86 PROCESSORS

Intel's Rivals Ready to Exploit P6 Weakness

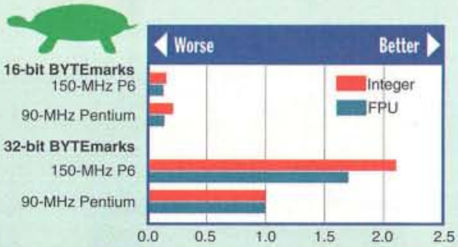
Benchmarks run on an early reference system confirm that the P6 is not the best chip for running 16-bit software. AMD and Cyrix say they won't have the same problem.

BY THE BYTE STAFF

The mediocre performance of the next-generation P6 processor on Windows and 16-bit DOS code creates an opportunity that Intel's competitors are eager to exploit. At least two of those competitors, AMD and Cyrix, say their respective next-generation x86-compatible processors, the K5 and the M1, will not suffer from the P6's defects when running Windows 3.1 or Windows 95 software.

As reported in BYTE last month (see "P6 Weakness Revealed"), preliminary benchmarks run by Intel indicated the P6 performs best when running 32-bit code. Older 16-bit and current mixed 16/32-bit code (as found in Windows 3.1 and Windows 95, respectively) that makes use of segment writes, partial register operations, unaligned data accesses, and instruction-prefix bytes stymies the P6. This is because when Intel started designing the P6 about five years ago, the company thought most code running on today's desktops would be 32-bit. Thus, the P6 was not optimized for 16-bit performance. BYTE recently confirmed the P6's poky 16-bit performance by running a variety of benchmarks, including a special 16-bit version of the cross-platform BYTEmark CPU and FPU benchmarks (see the figures below).

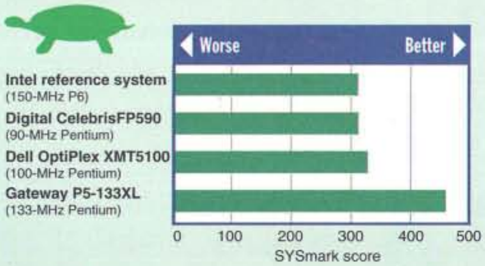
P6 Poky While Running 16-bit Software



A 90-MHz Pentium running 32-bit extended DOS in protected mode = 1.0.

BYTE's cross-platform BYTEmark CPU and FPU benchmarks confirm that a 90-MHz Pentium outperforms a 150-MHz P6-based system running 16-bit code. The performance of the P6 improves over that of the Pentium when running 32-bit code, as you would expect.

16-bit Application Performance Poor, Too



SYSmark scores are from the BAPco's SYSmark benchmark running a variety of Windows 3.1 applications.

The P6's difficulty with 16-bit code is less pronounced at the application level, but it's still noticeable. Practically any 100-MHz Pentium-based machine will outrace a 150-MHz P6-based computer when running Windows 3.1 applications.

AMD says its K5 has extra tag fields and comparators in the reorder buffer to handle partial register accesses more smoothly than the P6. Also, unlike the P6, the K5 can execute segment changes speculatively, a technique that avoids significant performance penalties.

Cyrix's M1 has special circuitry that makes its performance when handling segment-register writes, partial register updates, and instruction-prefix bytes better than that of the P6 when running 16-bit and mixed 16-/32-bit Windows code. Cyrix officials say the M1 will offer better 16-bit and equivalent 32-bit performance as the P6.

Tests performed on an early P6 reference system produced by Intel highlight the P6's 16-bit/32-bit performance gap. We ran a variety of benchmarks on a 150-MHz P6 reference system. The system had a 60-MHz I/O bus, 64 MB of two-way interleaved RAM, a Diamond Stealth Pro video card, and the P6's integrated, 256-KB secondary cache. Our tests indicate that for running 16-bit applications, you'll almost always get equal or better performance for less money if you buy a PC based on a 90-MHz or faster Pentium instead of one based on a first-generation P6 processor.

When running a 16-bit version of BYTE's cross-platform BYTEmark CPU/FPU benchmarks, our baseline 90-MHz Dell Pentium outperformed the 150-MHz P6 on all tests except the Fourier test. The reason the P6 won here is because every test except the Fourier test operates in a source/destination fashion.

With source/destination operation, the tests process a quantity of data (source) and output another quantity of data (destination). For example, the IDEA test reads a large array of text and encrypts it into a destination array.

All the source/destination-style tests must call the segment-offset calculation routine repeatedly. On the P6, this results in a performance penalty, because that routine involves a segment-register load.

If Cyrix and AMD can deliver processors that offer better 16-bit and comparable 32-bit performance as Intel's first P6, then both companies will likely sell more chips to users who want to maintain their investment in legacy code. But the window of opportunity is small. Microsoft's release of Windows 95 should push the market toward 32-bit software. And when Intel pumps up the P6's clock speed to 200 MHz, which is expected to happen later in 1996, the P6 should outperform the Pentium no matter what software it's running.

WINDOWS 95

Coming: A Better Multimedia Platform

Windows 95 includes numerous multimedia technologies, such as 32-bit video codecs, integrated MIDI and WAV audio, and support for enhanced audio CDs. But users will have to wait for other enhancements.

The first release of Windows 95 lacks a number of 3-D- and multimedia-related technologies, including OpenGL; support for hardware-assisted, full-motion video acceleration; and the Windows 95 game subsystem, among others. The lag time between the first release of Windows 95 and the appearance of additional multimedia capabilities could range from one to several months (see the table at right).

One key element that's missing from Windows 95 is support for full-motion video acceleration. This feature is missing because Microsoft removed support for the Display Control Interface (DCI) from Windows 95 earlier this year due to stability issues, according to company officials. Version 2 of DCI, which was to have incorporated several technologies for games and video-hardware acceleration, was replaced by the Direct series of APIs and the Windows 95 game subsystem.

Since DCI is not supported in Windows 95, and final code for implementing the Direct APIs wasn't slated to ship until late September, users will have to wait at least a month before new cards from such companies as Matrox, ATI Technologies, and Number Nine Visual Technology will be able to accelerate full-motion video movies in Windows 95. "Microsoft's road map for video acceleration has been quite wobbly," says an official at one hardware-acceleration company. "However, the situation should be sorted out by this fall."

Microsoft's plans for 3-D in Windows 95 have evolved, too, as the company is rolling out two new APIs to complement OpenGL. One new 3-D API, called RealityLab, is expected to enter general beta testing in September and ship commercially in 1996.

RealityLab, which Microsoft received when it acquired London-based RenderMorphics earlier this year, is a cross-platform, high-level, real-time API. The first applications written to another API, called Direct 3-D, could ship later this fall.

David Britton, group marketing manager for Windows 95 multimedia, says RealityLab is for developers who want to write consumer, business, and some virtual-reality applications using a high-level API. Direct 3-D, meanwhile, targets a different type of developer—one "who wants to get every ounce of speed and performance from the system," Britton says. Thus, Direct 3-D should appeal to developers of high-paced action games. The target market for OpenGL, which is currently available for Windows NT 3.51 and slated to ship for Windows 95 next year, is still high-end professional CAD and modeling applications. Some vendors wonder if OpenGL will ever ship for Windows 95.

Microsoft's Britton says the company will continue to improve upon Windows 95's multimedia capabilities. "You have two waves here," he says. "The first release of Windows 95 already has a faster GDI [Graphical Device Interface], 32-bit video, and other enhancements. And then, starting in September, a whole new suite of software will come out; we'll be supercharging Windows 95."

Until that happens, however, perhaps the fairest grade to give Windows 95's multimedia support is an *I*, for incomplete.

—Dave Andrews

FUTURE WINDOWS 95 MULTIMEDIA SCHEDULE

COMPONENT	COMMENT	DUE DATE
Software MPEG playback	Will allow about 24 frame-per-second playback of CD-ROM MPEG movies on high-end Pentium-based PCs.	Undetermined.
Windows 95 Game Subsystem	Allows programs written to the Direct series of APIs (e.g., DirectDraw) to execute under Windows 95.	First version, to be distributed by independent software developers with their applications, may ship in late September. Time frame for inclusion in Windows is undetermined.
DirectDraw, DirectSound, DirectPlay, DirectInput APIs	Games and multimedia APIs that allow hardware-accelerated 2-D video, high-performance sound, networked multiuser support, and digital joysticks.	The first applications and drivers for hardware-accelerator cards could appear in late September.
Direct 3-D device driver interface	Driver interface for hardware developers that lets boards accelerate multiple 3-D APIs used by software developers.	Expect applications and drivers for hardware to begin appearing this fall.
Direct 3-D	Low-level API for software developers, especially those developing games, who want fast 3-D performance.	The first Direct 3-D applications might appear this fall.
RealityLab 3-D API	High-level, real-time 3-D API for developers writing consumer, business, and virtual-reality applications.	Expected to enter broad beta testing in September. Expect final code and the first applications in the first quarter of 1996.
OpenGL	High-end 3-D API for developers writing professional CAD, modeling, and other engineering applications.	Available now in Windows NT 3.51, but Windows 95 availability is slated for 1996.
Surround Video	A 360-degree multimedia environment (for more information, see "See You Around," May BYTE).	Undetermined.

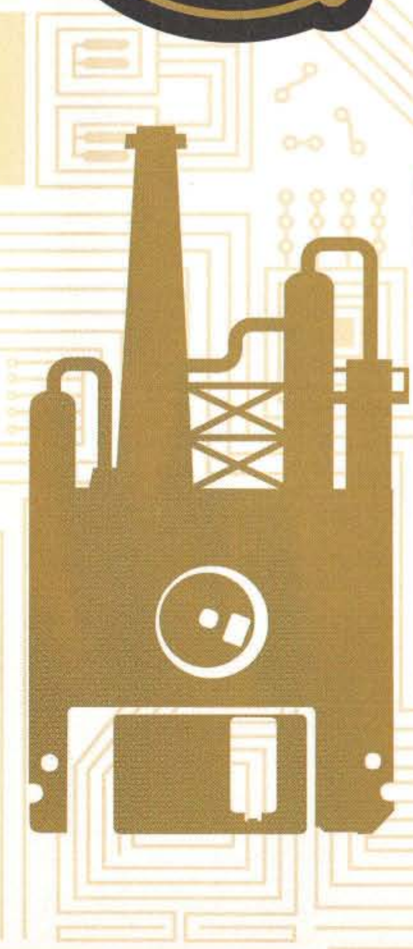
Get a Fast Start on the Automation Learning Curve!

Devoted exclusively to the computing needs of chemical engineers, Chemputers Europe II brings together leading software developers and users from around the globe. This year's conference will feature dozens of papers from key innovators in engineering software, and from pioneering chemical manufacturers and engineers testing and using the latest software.

An adjoining Demonstration Hall will feature exhibits by many of the companies participating in Chemputers Europe. There will be ample opportunities to meet with these leading vendors to obtain more information, and to "test drive" the industry's hottest new products.

The Chemputers Europe II program is broadly divided into two tracks: Process and Plant Design, and Plant Operations and Management. Within these tracks, the following sessions and papers have been scheduled:

Chemputers



PROCESS AND PLANT DESIGN

(includes process simulation, estimating, CAD and design optimization)

Detailed Design, Estimating and Scheduling Software

K. Adamson, Product Manager, EA Systems Inc. and R. Steinberger, Director, Icarus Corp. USA

Process Simulation in Chemistry and Environmental Technology

W. Schmidt, Chemstations Europe, Germany

The Plant Data Life Cycle

G. Stiksma, Project Automation Manager, Fluor Daniel, Netherlands, and Frank Joop, PDS Manager, Intergraph, USA

Dynamic collaboration: The next decade of process computing

John Voeller, Black & Veatch, USA

The design of Steam Reformers using Computational Fluid Dynamics

F.P. Waterrus, C. van Leeuwen, Kinetics Technology International B.V., The Netherlands

CFD studies on the influence of impeller spacings on Flow Fields and Mixing Times in Stirred Vessels

R.S.H. van der Geest, Research Scientist, Unilever BV, The Netherlands

PLANT OPERATIONS AND MANAGEMENT

(includes process control, manufacturing execution systems, advanced control, engineering document management, training, maintenance and environmental monitoring)

A structured approach to Automating Complex Batch Processes

A. Pampel, AFP Consulting; J. Vreysen, System Manager, Elsag Bailey Process Automation, Belgium

Large-scale Process Simulation-The System Architecture Requirements

P. Van Santen and J. van Loon, Marketing Manager, Setpoint BV, The Netherlands

Online Optimization of Process Operations

S. Mullick, Research Scientist, Simulation Sciences, USA

Standardized Plant Life Cycle Data

Ben Maasman, Akzo Nobel Engineering, Netherlands

Application of multivariable control to MTBE production

Doug Robertson, Staff Engineer, DMC Corp., USA

A new approach to online optimization

Peter Winter, European Director, Sacda UK

Computerized process management boosts industry profits

C.W. Taylor, Technical Manager, Marex Technology, England

Manufacturing Execution Systems—Requirements and New Developments (Capisce)

T. Allweyer, Research Scientist, Institute for Information Systems, W. Saarland

Manufacturing Execution Systems: A Corporate Initiative with a Supplier's Collaboration

Phil Hannay, Cargill Inc., USA, George Turanchik, GSE Process Solutions Belgium NV, Belgium

Plantwide information systems: Application in a mineral oil treatment plant

J.E. Hille, Eurostill B.V., The Netherlands

Manufacturing Execution Systems in the production of chemicals

B. Adams, Vice Pres., Incode Europe, England

PDXI Progress report

M. Dalton, Eastman Chemical Co., USA; Stewart Goldfarb, Simulation Sciences, USA (Chairman and Vice-Chairman of PDXI Technical Committee)

RELIEF: A computer package for Emergency Pressure Relief Studies

J.S. Duffield, EU Joint Research Center, Italy

Advanced Training Simulation for Sulfur Recovery Units

A.N.S. Mak, Comprimo BV; C. Geen, Sacda UK Ltd.

Multi-purpose dynamic simulation-Making the most of simulation investments

Richard Bailey, BP Intl., UK; Mark Matzopoulous, Cape Software Ltd., UK

EGIS: A contribution to the standardization of environmental software and databases for the chemical process industries

K. Kaiser, J. Schwab, Technidata GmbH, Germany

PLUS: *The Internet for Chemical Engineers: A hands-on session of demonstrations and talks on what is happening in this fast-moving new medium*

PLUS: *Panel Discussions*

Each track will conclude with a panel discussion of leading developers in process design and plant operations. Discussion topics include:

DYNAMICS OF PLANT CONTROL AND SIMULATION

INTEGRATING DESIGNS AND DATA IN THE PLANT LIFE CYCLE

PROGRAM SUBJECT TO CHANGE. ADDITIONAL PAPERS ARE NOW BEING SCHEDULED!

Hosted Meetings

A number of related meetings are being held in conjunction with Chemputers Europe II. These meetings will provide additional opportunities for exploring specific topics in more detail. The current lineup:

ECOS at Chemputers

Simulation Sciences' European Conference on Open Simulation. Free to all Chemputers attendees, ECOS features presentations on the implementation of Microsoft and other standards in PROvision. Oct. 12.

PlantSTEP European Industry Review Board

Emerging standards for Electronic Data Interchange, focusing specifically on the activities of STEP consortium. Free to Chemputers atendees. Oct. 10.

European Batch Forum (EBF)

EBF's Annual Fall Meeting will focus on the recently completed SP88 Part I standard for batch control, and will look at the implementation of both Part I&II of this standard. EBF attendees can participate in the Chemputers Conference at no extra charge. Oct. 11-12.

Europe II

October 10—12, 1995 Noordwijk, The Netherlands

Registration Form

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Fax: (212) 512.6111

Registration fee: $350 (NGL 570). This includes two days of technical sessions, plus the PlantSTEP meeting on Oct. 10, day/evening hours at the demo hall, conference materials, continental breakfast, lunch and a reception hosted by Chemical Engineering.

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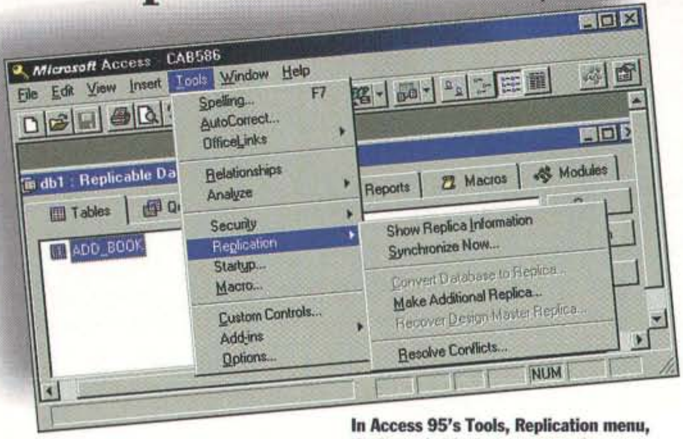
DATABASE TRENDS

New Replication Options in Access, Oracle, and Notes

The new 32-bit version of Microsoft's Access for Windows 95 database, which is slated to ship this fall, offers a host of new features. But one that should especially appeal to developers supporting remote workers is replication. Made popular by Lotus Notes and introduced for enterprise databases, such as Oracle 7, replication allows Access 95 users to work remotely with a copy of the master database and later incorporate all their changes into the master database.

Based on use of a beta version of Access 95, the easiest way to use the database's replication is through the Windows 95 Briefcase. Making a database replica is as easy as dragging and dropping a database file from a server into the Briefcase of a notebook PC that's docked to your network.



In Access 95's Tools, Replication menu, the items in black-on-gray are for managing replicas after a database is converted to a design-master replica. The options in gray list selections for converting a database to a design-master replica and recovering from a faulty design-master replica.

Because Windows NT 3.51 does not have the Briefcase interface, users of that OS (as well as Windows 95 users) can control Access replication in two ways: by using the Tools, Replication menu, which provides commands for controlling replication, or by using Visual Basic for Applications, which replaces the Access Basic programming language used in older versions of Access.

ACCESS 95

GOOD FOR:

- Letting mobile workers periodically synchronize their remote databases with the home-office version.
- Letting small businesses synchronize database replicas across a few offices.
- Database administrators who want to balance the load on a database by directing users to replicas.
- Developers who want to distribute design updates through Access replication.
- Database backup (only changes are replicated).

BUT NOT FOR:

- Replicating Access 95 data directly with Microsoft's SQL Server.

Dropping a database file into the Briefcase of a connected portable computer initially creates a regular replica and a design-master replica. The regular replica is used for updating data changes. Database developers use the design-master replica to propagate database-design changes to other replicas.

Access 95 offers replication management tools and automatic conflict resolution. But these tools don't offer quite the level of granularity that other programs, such as Lotus's (Cambridge, MA) Notes 4.0 and an upcoming version of Personal Oracle 7 from Oracle (Redwood Shores, CA), do.

Conflict resolution in a replication is the process of reconciling changes to two replicas that are inconsistent. If, for example, in one replica a customer's Bill To address changes, but in another replica the Ship To address of the same record changes, the two records conflict when they're synchronized at the record level.

Access's approach is to assign a "winner" based on which record has changed most often. If both have changed equally often, Access picks a winner randomly. This is in contrast to Personal Oracle 7 for Windows 95, slated to ship this fall, which will be able to take advantage of 10 preprogrammed rules for replication-conflict resolution that are included in Enterprise Oracle. Enterprise Oracle also enables the database developer to write custom conflict-resolution rules.

Unlike the previous version of Personal Oracle 7, which only let you replicate with a server in publish-and-subscribe (aka read-only) mode, the new version will support full symmetric replication to let it bidirectionally replicate with the large, mission-critical databases typically developed using the Enterprise Oracle database management system. Access 95 will not directly replicate with Microsoft's SQL Server database; however, officials at Microsoft say that capability might be added to a future version of Access.

Replication Manager, which will be released with the Access Developer's Toolkit, adds functionality and simplifies management. This Access component permits the scheduling of replication for particular times, such as 3:00 a.m., and the setting of synchronization rules for the sequence of replication among replicas. It also provides a "dropbox," a network location for holding replica updates. When replicas become connected to the network, they can update themselves with the dropbox contents.

But neither Oracle nor Microsoft supports field-level replication, which is promised for Notes 4.0, the Lotus groupware platform that's now slated for availability in the fourth quarter of this year. Field-level replication accelerates synchronization by reducing the amount of data that's passed in a replication.

For instance, if one field changes in a record (which is actually a document in Notes), then, instead of the whole document being passed in the replication, just a single field is passed. Field-level replication's increased efficiency bodes well for administrators who manage worldwide Notes networks.

Desktop users will have a rich array of replication options available in the fourth quarter of this year. Access 95 provides this functionality to a whole class of department-level developers. Personal Oracle tightly integrates with Enterprise Oracle to deliver some of the rich functionality of its flagship product. Lotus will reduce the time needed to replicate databases with Notes 4 when it rolls out field-level replication. **—Rick Dobson**

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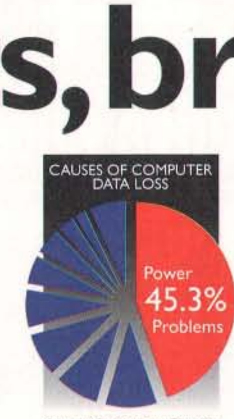
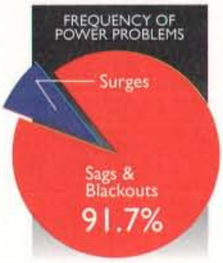


Source: Contingency Planning



Source: Bell Laboratories

IN THE NEXT THREE MONTHS, MORE THAN 30,000,000 PCs WILL BE HIT BY POWER PROBLEMS...

Who needs power protection? If you use a computer, you do. A study in a recent *PCWeek* showed that the largest single cause of data loss is bad power, accounting for almost as much data loss as all other causes combined. Every PC plugged into an outlet is vulnerable. In fact, you have better odds of winning the lottery than of escaping the sting of power problems. One study found a typical PC is hit over 100 times a month, causing keyboard lockups, hard drive damage, and worse.

Simply put, if power problems are the least of your troubles, you've got one chance to keep it that way. You insure your car and home with the best policy you can afford. It just doesn't make sense to leave your PC (which is at far greater statistical risk) vulnerable to loss or damage.

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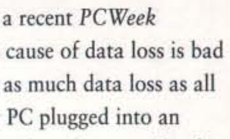

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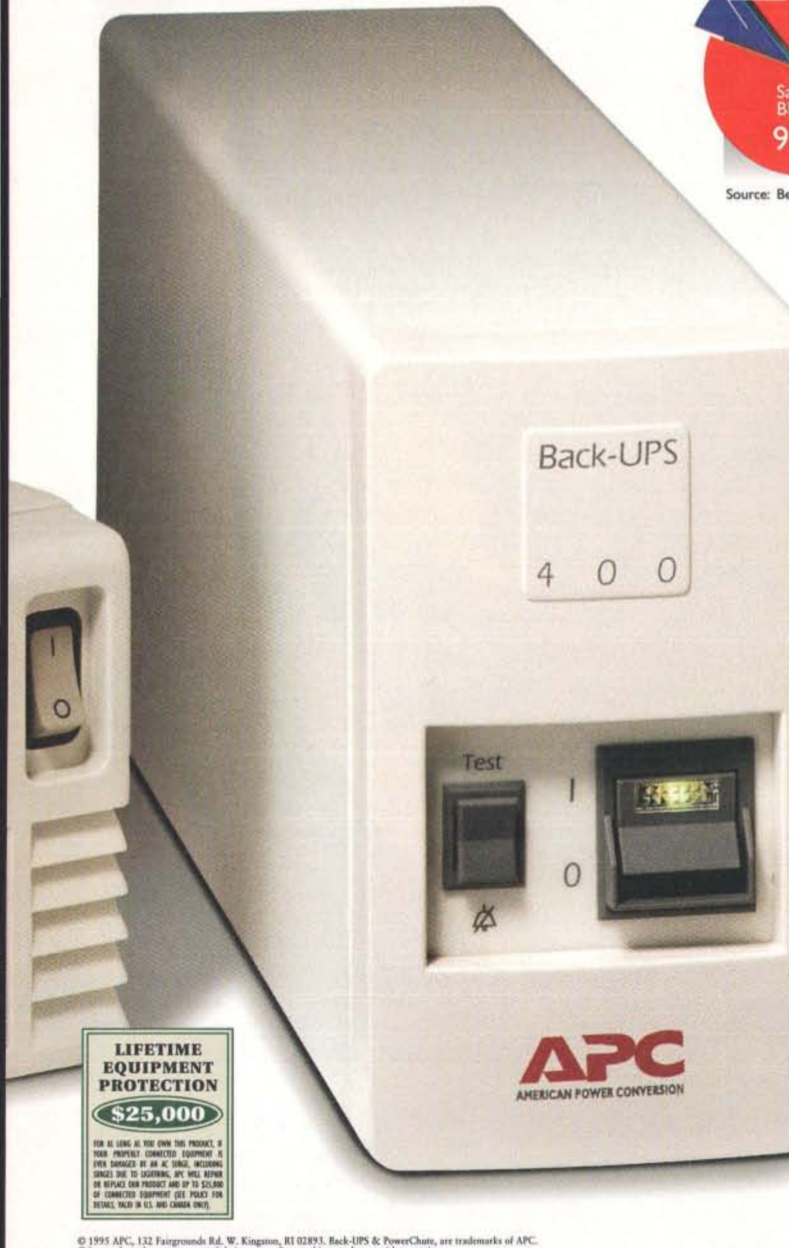

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protection against and other trials by fire

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After a raging fire which took 18 trucks to subdue, Michael Benolkin, director of the Systems Division at Correa Enterprises, Inc. didn't expect much. "While rummaging through the ashes, we heard something beeping. Our four APC units were still in action, while two UPSes from another brand were history. We're still using these same APC units at our new office location - they still work like a charm! We're impressed with the ruggedness, reliability, and product support offered by APC."

Trial by Fire

Brian Krause, Network Manager for Goodyear Airship Operations, knows how critical APC protection can be." The night of the All-star game a tornado came through our blimp hanger and took out our roof. Our airships demand absolute communication so I protect our local and remote servers with the most reliable protection I can find: APC. APC's PowerChute software shut our server down in an orderly way... closed out all files nice and neatly. When we reconnected, everything came back up perfectly, without a hitch."

Trial by Air

Doug Welch learns his reliability lessons well: "While still a Computer Science student, I was at home preparing a large spreadsheet for a final project when Anchorage experienced an all too common 5+ Richter earthquake. If not for my Back-UPS 400 it would have been back to square one! I'm now the Network Systems Manager at Charter College, in charge of three networks. I learned my UPS lesson well back in my student days. I've never been disappointed with APC and the product has had quite a work out."

Trial by Earth

Faced with a water main break, Mark Conley, Regional Manager of Novell's remote sales office in Detroit was amazed at APC's reliability. "The APC unit was sitting in an inch and a half of water, working just fine, as though nothing was unusual and we lost no data to this disaster. We've used APC here now for at least four years - more than a dozen units are all around the office, and we're well satisfied, so we were even more impressed to learn that the units are amphibious!"

Trial by Water

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Model	Application	Sugg.List
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600	CAD/CAM workstations	$359
900	Longer runtime	$529
1250	Multiple systems	$689

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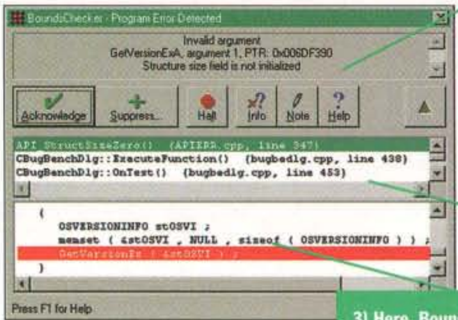
PROGRAMMING TOOLS

Run-Time Error Checking Comes to Compilers

The familiar programmer's grind—compile, run, debug, and repeat as necessary—will have another major step added to it if proponents of run-time error checking have their way. Borland, Microsoft, and Nu-Mega Technologies are making strong efforts to integrate this reliability-enhancing technology more deeply into the programming cycle by hooking run-time error checkers directly into the Borland C++ and Microsoft Visual C++ integrated development environments (IDEs).



```
Invalid argument
GetVersionExA, argument 1, PTR: 0x006DF390
Structure size field is not initialized

API StructSizeZero()   (APIERR.cpp, line 347)
CBugBenchDlg::ExecuteFunction()   (bugbedlg.cpp, line 438)
CBugBenchDlg::OnTest()   (bugbedlg.cpp, line 453)

   {
      OSVERSIONINFO stOSVI ;
      memset ( &stOSVI , NULL , sizeof ( OSVERSIONINFO ) ) ;
      GetVersionEx ( &stOSVI ) ;
   }
```

1) Nu-Mega's Bounds Checker Professional indicates an invalid argument, the cause of which was an uninitialized structure-size field.

2) The middle pane shows the call stack.

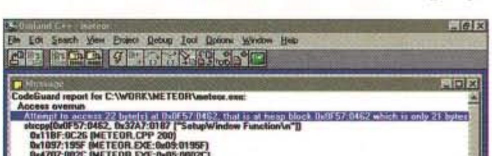
3) Here, Bounds Checker Professional displays the source code, with the offending code highlighted.

Tools vendors have always supplied programmers with expressive languages, such as C, and prewritten code in programming libraries, which lets developers write more powerful applications for end users. Meanwhile, in today's highly competitive market, programmers must race to add new features to their programs. However, the difficulty of tracking memory and resource allocation grows with the use of higher-level APIs and language extensions. The result of these two trends is often more features—but also more bugs—in applications.

"Top quality is not the winning market feature in applications today," says Jim Moskun, chief technology officer at Nu-Mega (Nashua, NH, (603) 889-2386). Nu-Mega hopes to help reverse that trend with its Bounds Checker Professional, slated for September announcement (price at press time was undetermined).

The company's current Bounds Checker for Windows, which automatically flags memory and resource leaks, monitors illegal address references, and validates Windows and C-library APIs, established the Windows run-time error-detection category of tools. But Bounds Checker, according to Nu-Mega president Frank Grossman, is used primarily in the quality-assurance stage of program testing, in which a programmer often receives an error report months after writing an errant module.

Bounds Checker Professional, in contrast, is designed for daily use, allowing programmers to catch errors while the code is still fresh in their minds. "We want programmers to check early and check often," says Grossman. The program integrates directly into the Visual C++ environment on the toolbar, making it as easy to error-check a program as it is to merely run it. The program also enables programmers to do such things as ignore validation flags or errors by module or by function, which allows team members to check only the files that they've modified, or ignore a known bug in application framework code.


File Edit Search View Project Debug Tool Options Window Help
Message
Inspection: buf_h

```
CodeGuard report for C:\WORK\METEOR\meteor.exe:
 Access overrun
   Attempt to access 22 byte(s) at 0x0F57:0462, that is at heap block 0x0F57:0462 which is only 21 bytes
   strcpy(0x0F57:0462, 0x37A7:0187 ["SetupWindow Function\n"])
     0x11BF:0C26 (METEOR.CPP 200)
     0x1097:195F (METEOR.EXE:0x09:0195F)
     0x4707:002C (METEOR.EXE:0x05:0002C)
     0x4707:068C (METEOR.EXE:0x05:0068C)
     0x1097:1538 (METEOR.EXE:0x09:01538)
     0x1097:16EB (METEOR.EXE:0x09:016EB)
   The memory block (0x0F57:0462) [size: 21 bytes] was allocated with malloc
     0x11BF:09A7 (METEOR.CPP 164)
```

CodeGuard hooks into the Borland C++ 4.5 IDE, detecting memory and resource errors and validating API parameters in a one-step process for programmers writing 16-bit Windows programs.

Bounds Checker Professional's ability to let project managers establish libraries of acceptable errors lets a manager give each programmer a readily definable mission: Make every module run cleanly through error checking. Nu-Mega's error-detection software will run with all Visual C++ environments.

Microsoft (Redmond, WA, (206) 882-8080) is also making run-time error detection a more integral part of its upcoming Visual C++ 4.0 by including C debugging libraries. These libraries should help programmers identify problems that occur at the interface between the user and Microsoft-supplied code.

Borland (Scotts Valley, CA, (408) 431-1000) is also releasing new error-checking programs. Although Bounds Checker Professional works with Borland and Symantec compilers, it is tightly bound only to Microsoft's Visual C++ IDE. Borland's new CodeGuard program brings a similar level of error-checking integration to the Borland camp.

CodeGuard hooks into the Borland C++ 4.5 IDE, detecting memory and resource errors and validating API parameters in a one-step process for programmers writing 16-bit Windows programs. CodeGuard isn't quite as expert as Bounds Checker Professional is at handling tricky API problems, but Borland officials say they will continue to add capabilities to their program.

As tool vendors put run-time error detection into the hands of every programmer, developers and end users alike will benefit. Developers will become more efficient and effective, while users will get better, more reliable programs. **—Steve Apiki**

Whatever Happened to...?

OS/2 for PowerPC?

(see "OS/2 on the PowerPC Slated for This Year," June 1994 BYTE)

The official word from IBM is that OS/2 for the PowerPC is expected to enter general beta testing this fall and to be released by the end of the year. IBM has shown preliminary versions of OS/2 running atop PowerPC hardware at several industry trade shows over the past several months, but performance on these demonstration machines was poky.

The delay of OS/2 for the PowerPC means that IBM's new PowerPC-based Personal Computer Power and ThinkPad Power series of computers and notebooks can run only Windows NT or AIX. Meanwhile, Canon (Costa Mesa, CA) is positioning its new PowerPC-based Power Workstation line of systems and notebooks as "PowerPC Windows NT solutions." **—D. A.**

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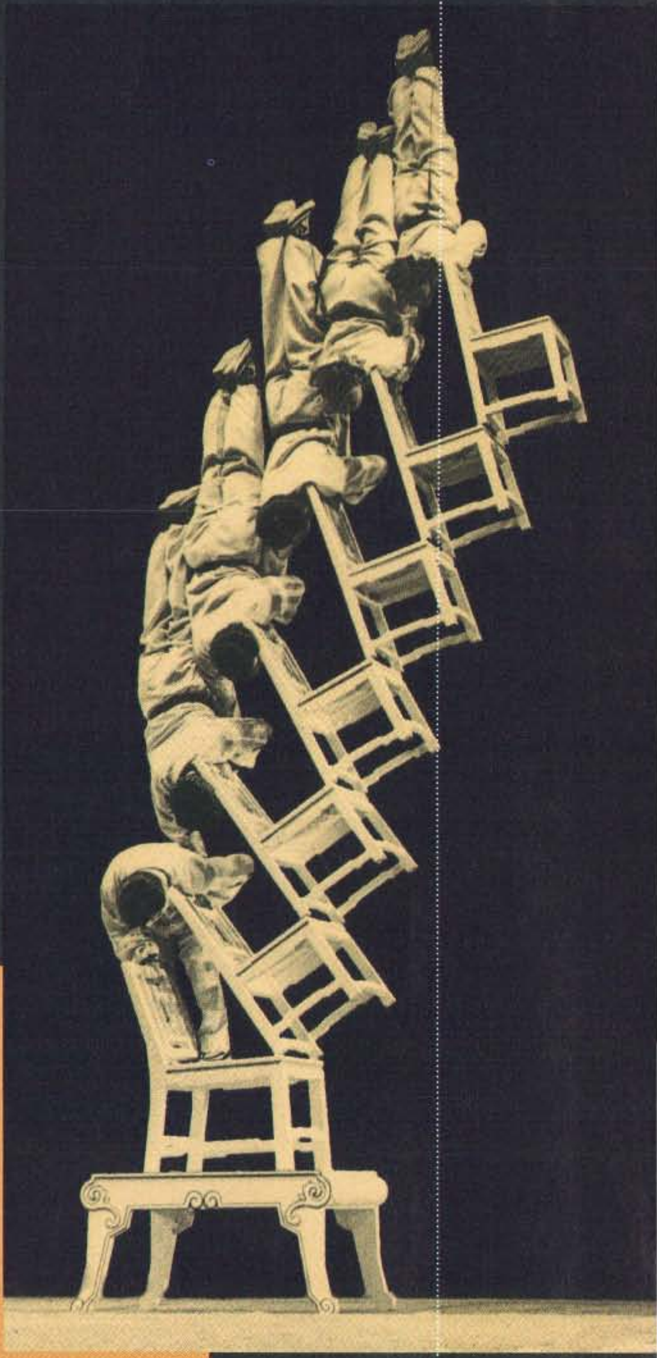

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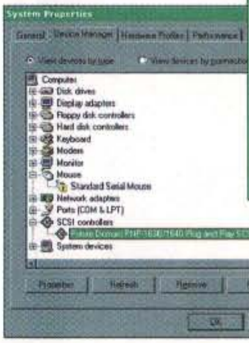
see
what's
possible

WINDOWS 95 PLUG AND PLAY

We Plugged, but They Didn't All Play

Windows 95 brings together a variety of components to make installing new peripherals in a PC as easy as upgrading a Mac. But tests of several new Plug and Play (PnP) devices show that unless you have all the required pieces in your PC, you can expect to do a lot of work before you get to play.

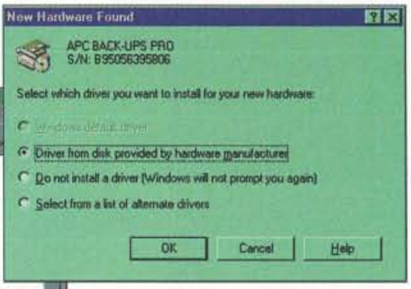
Various pieces of the PnP puzzle were available prior to the release of Windows 95 (see "Transforming the PC: Plug and Play" in the September 1994 BYTE). But the piece that pulls it all together is a PnP OS. Thanks to the arrival of Windows 95, the promise of PnP on the PC has at last become a reality—sometimes.



When we installed a Future Domain SCSI controller, the PC recognized the device automatically. Even better, the PC performed properly after we removed the SCSI controller.

BYTE tested several new PnP devices, legacy SCSI and network adapters, and a new uninterruptible power supply (UPS). To evaluate how the new devices will fare in the typical office containing older PCs, we tested them on legacy computers that don't have a PnP BIOS. Our tests show that if you have a variety of legacy equipment, you may need to pray before you play.

One peripheral that we tested, the American Power Conversion BackUPS Pro 650 UPS from APC (West Kingston, RI, (401) 789-5735), highlighted the benefits of PnP when it works, as well as the frustrations that you can expect when it doesn't. When PnP worked, configuring the BackUPS Pro was a breeze. We plugged in the AC cord, connected the serial cable to our PC, turned on the UPS, and rebooted the PC. Windows 95 detected the presence of the new UPS and presented a dialog box (see the screen above).



APC BACK-UPS PRO
S/N: B95056395806

Select which driver you want to install for your new hardware:

○ Windows default driver
● Driver from disk provided by hardware manufacturer
○ Do not install a driver (Windows will not prompt you again)
○ Select from a list of alternate drivers

When we installed APC's UPS, Windows 95 detected the new device and presented this dialog box, which prompted us to install software from a floppy disk. If we had loaded the Windows 95 installation CD into the PC's CD-ROM drive, this dialog box would not have appeared; instead, the APC software would have installed directly from the Windows 95 CD.

If we had loaded the Windows 95 installation CD into the PC's CD-ROM drive, the process would have been even smoother. The dialog box would not have appeared; instead, the APC software would have been installed directly from the Windows 95 CD. Regardless, once the APC software was installed, we didn't have to tell the software which serial port to use, set the data transfer rate, or perform any of the other operations that adding UPSes has traditionally required.

This magic involves a handshake between Windows 95 and the APC UPS. During boot-up, Windows 95 sends out a query on the serial port. The APC UPS responds with a message that includes the product's name and serial number. If Windows 95 doesn't recognize the device from its hardware list, it then begins the installation process described above.

The APC UPS/Windows 95 combination worked fine on an old no-name clone PC, but it didn't work on a much-newer Zeos Pantera. Neither system had a PnP BIOS, but both should have been able to complete the auto-detection and automatic software installation. Nothing we tried could get the Zeos/Windows 95/APC combination to work automatically. We finally resorted to a manual installation, using the Add Hardware applet in the Control Panel.

Adding a UPS isn't too difficult a process, since it's an external peripheral. Where PnP is really supposed to help is when you add an internal card, as well as after you've installed it; you can reconfigure PnP cards without having to reopen your computer.

To test this capability, we first tried an EtherEZ 10Base-T network adapter from Standard Microsystems Corp. (SMC, Hauppauge, NY, (800) 762-4968). This time we installed the Windows 95 CD before putting in the card. When we rebooted, the PC detected the new adapter and installed the software from the CD without any additional intervention on our part.

But unfortunately, the computer had previously been using a non-PnP NE2000-compatible adapter. Because this older adapter wasn't a PnP device, Windows 95 still loaded its driver, even though the card was no longer installed. The Windows 95 Device Manager indicated an error in using the NE2000-compatible device, but the Microsoft Networking log-in did not; it simply said that no domains were available.

From the Device Manager, it was a relatively simple matter to remove the NE2000 device. Even so, after we plugged in the PnP network adapter, it took an awful lot of configuring and rebooting before we got it to work.

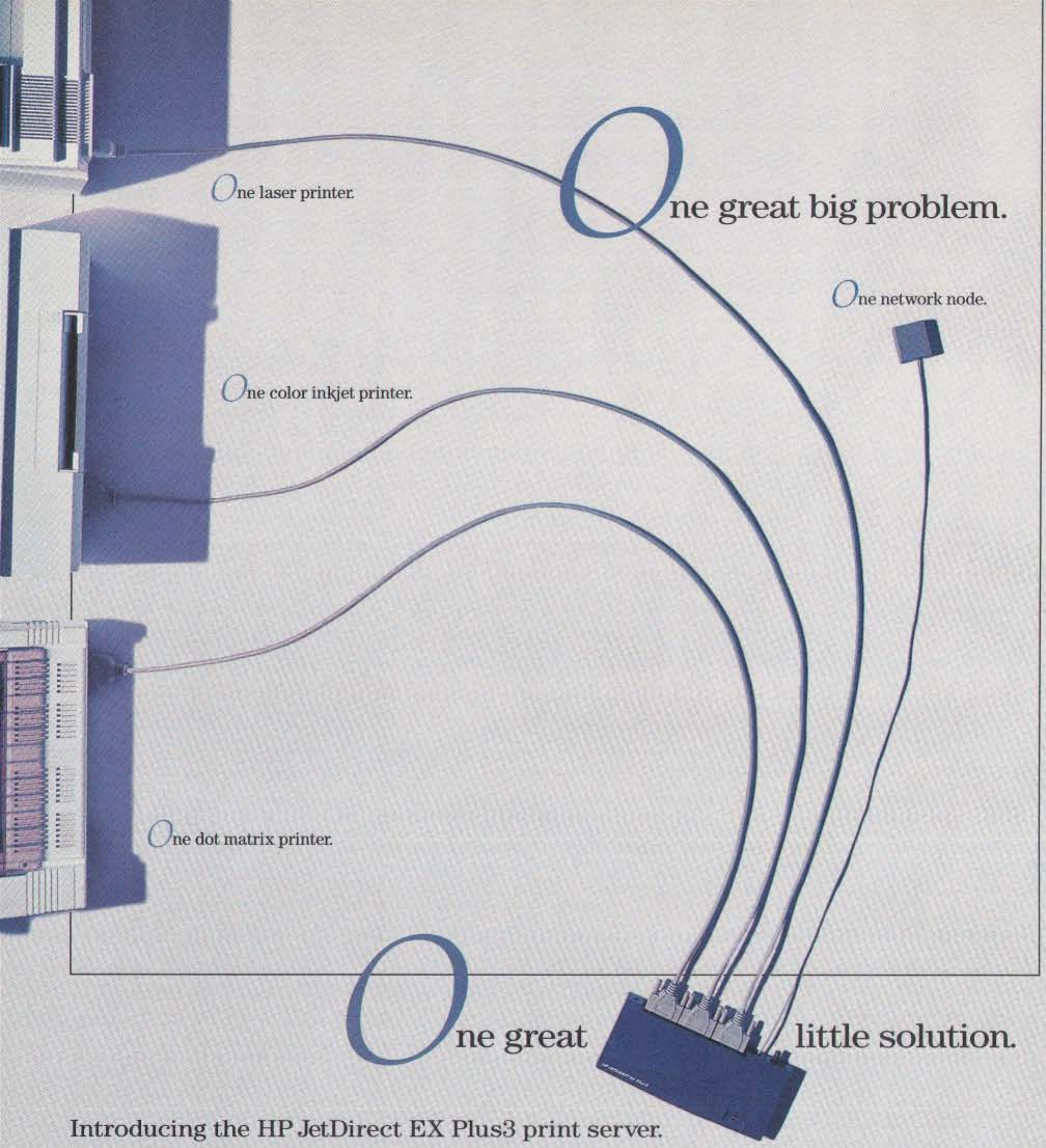
Our only true success story was with the Future Domain (Irvine, CA, (714) 253-0400) PNP-1640 SCSI controller (see the screen at left). The PC initially detected the new card much as it did the APC UPS and the SMC EtherEZ. But even better, whenever we removed the Future Domain card and then rebooted the PC, the device driver did not load, and no entry appeared in the Device Manager.

Note that our mouse, which was not a PnP device, showed an error because it was not plugged into the serial port. If the mouse had been PnP compatible, Windows 95 wouldn't have loaded the driver at all.

PnP promises a better future for those who want to upgrade their PCs. But as our experience illustrates, PnP works best when everything—the BIOS, the OS, all the attached devices, and your applications—are PnP compatible. This is welcome news for vendors who want to sell new PnP products, but not such great news for system administrators. For those without a PnP BIOS, the combination of Windows 95 and PnP devices still brings benefits. But adding new devices is still not without some pain, and the experience is rarely as simple as plugging something in and turning it on.

—Rex Baldazo

One great big problem.



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PC MAGAZINE EDITORS' CHOICE

LAN TIMES READERS CHOICE 1995

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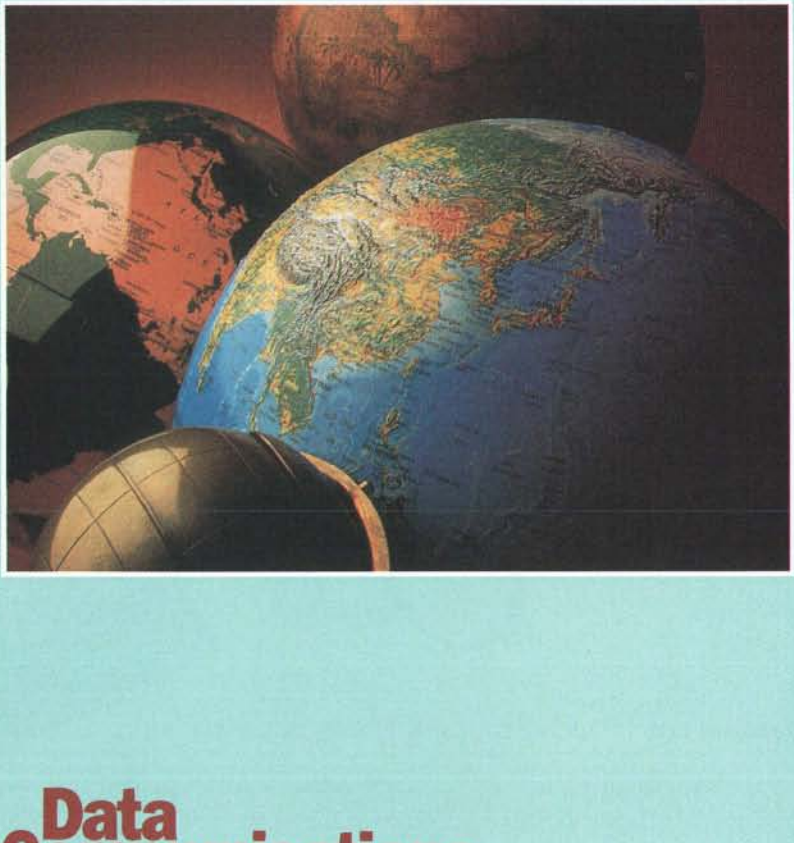

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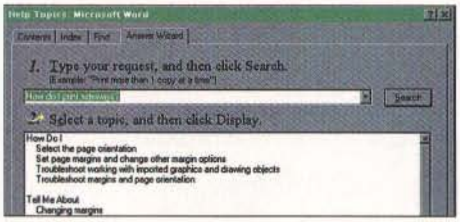
APPLICATION TRENDS

Help Gets Natural



1. Type your request, and then click Search.
(Example: "Print more than 1 copy at a time")

How do I print sideways?

2. Select a topic, and then click Display.

How Do I
  Select the page orientation
  Set page margins and change other margin options
  Troubleshoot working with imported graphics and drawing objects
  Troubleshoot margins and page orientation

Tell Me About
  Changing margins

In Microsoft's Word for Windows 95, when you ask a question such as "How do I see what this document looks like before printing?," you get a list of help topics that help answer your question.

To learn how to use the software they depend on, computer users have for years either dialed up technical-support lines or asked friends and coworkers. Now they can ask their software instead, using plain English.

A new capability, dubbed natural-language processing (NLP), allows a stumped user to type in a question such as "How do I get these numbers into a bar graph?" In response, the software directs the user to an appropriate help screen or a step-by-step tutoring routine.

These NLP features are showing up in new versions of programs from Lotus, Microsoft, Novell, and other software vendors. Microsoft's (Redmond, WA, (206) 882-8080) Office 95, for example, contains an Answer Wizard that lets you type in anything ranging from a few words to a complete statement or question in search of help.

Lotus's WordPro for Windows has a similar feature called Ask the Expert, which prompts you to complete a "How Do I" question and then takes you to the appropriate help screen.

Novell's WordPerfect Division (Orem, UT, (801) 429-7000) says it plans to apply a host of NLP features to the next edition of Perfect Office, which is due to ship by the end of this year. A query in Perfect Office will yield not only help screens but also interactive "coaches," templates, and "quick task" routines.

The next step will be to let users ask their computers questions by talking rather than by typing. Novell is already planning a 1996 or 1997 version of Perfect Office that will take NLP to the next level: voice recognition of plain-English questions. **—Chris O'Malley**

OPTIONS INCREASE, PRICES DROP FOR MAC ADD-ONS

Mac users will find a wide variety of options this fall when choosing graphics accelerators for their PCI Power Macs. The entry of such companies as ATI Technologies, Matrox, Number Nine Visual Technology, and others into the PCI-based Mac market means that Mac users can choose from a range of peripherals that cost less than comparable cards developed for the older NuBus. "There is more competitiveness now in the PCI Mac market," says Tony Bojorquez, product marketing manager for graphics cards at Radius. "Our PCI products are consistently [priced] lower across the board than comparable NuBus products," he adds. It also appears that some vendors selling PCI cards for both the Mac and PC markets will keep their prices the same. For example, Number Nine's Imagine 128 for Power Mac sells at the same price as its PC cousin. Other vendors, including Matrox and Miro, will price their Mac accelerators slightly higher. **—D.A.**

COMPANY	PRODUCT	DESCRIPTION	SUGGESTED RETAIL PRICE
ATI Technologies Thornhill, Ontario, Canada (905) 882-2600 fax: (905) 882-2620	Xclaim GA	24-bit color at up to 1152- by 870-pixel resolution (4-MB version) or 832 by 624 resolution (2-MB version)	$649 (4-MB) and $449 (2-MB)
Diamond Multimedia Systems San Jose, CA (408) 325-7000 fax: (408) 325-7070	Javelin Video 3240XL and 3400XL	24-bit color at up to 800 by 600 resolution and 24-bit color at up to 1152 by 870 resolution, respectively; both offer QuickTime video scaling and dithering acceleration	3240XL, $399; 3400XL, $569
Matrox Dorval, Quebec, Canada (514) 969-6320 fax: (514) 969-6363	MGA Millenium for the Mac	Mac version of graphics and 3-D accelerator	$649
miro Computer Products Palo Alto, CA (415) 855-0940 fax: (415) 855-9004	Five PCI cards for the Mac, including the miroChroma 1280PV	24-bit color at up to 1280 by 1024 resolution; displays and captures VHS and Super-VHS video; 30-fps QuickTime movies at up to 1280 by 1024 resolution	Price for miroChroma 1280PV undetermined
Number Nine Visual Technology Lexington, MA (617) 674-0009 fax: (617) 674-2919	Imagine 128 for the Power Mac	128-bit graphics and video accelerator; up to 1600 by 1200 resolution with 16.8 million colors (8-MB version); up to 1600 by 1200 resolution at 65,000 colors (4-MB version)	$899 (4-MB) or $1599 (8-MB)
YARC Systems Newbury Park, CA (800) 275-9272 fax: (805) 499-4048	Screamer, Hydra, and RIP	The Screamer accelerates QuickDraw 3-D applications; the dual-processor Hydra accelerates rendering; RIP converts the Canon color copier into a networked printer	$995, $1995 and up, and $14,995, respectively
Radius Sunnyvale, CA (408) 541-6100 fax: (408) 541-6150	Several products, ranging from the low-end PrecisionColor 8/1600 to the high-end ThunderColor 30/1600	24-bit color at up to 832 by 624 resolution (PrecisionColor 8/1600); 24-bit color at up to 1600 by 1200 resolution, plus DSP-accelerated Photoshop and CMYK display (ThunderColor 30/1600)	$599 for PrecisionColor 8/1600; $2499 for ThunderColor 30/1600
Radius	Thunder IV GX 1600 for NuBus	Comparable to the ThunderColor 30/1600	$3699

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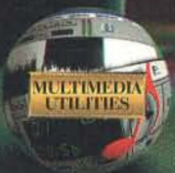

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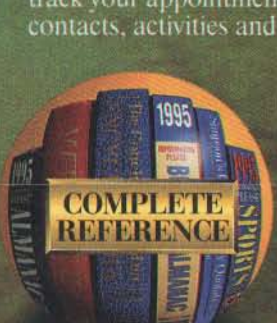

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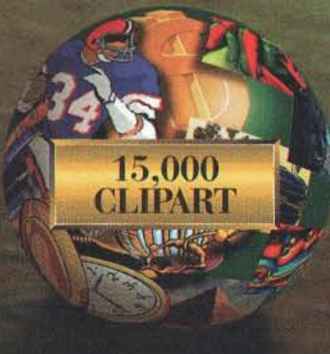

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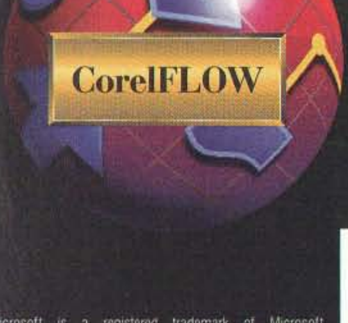

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We are Gateway 2000.

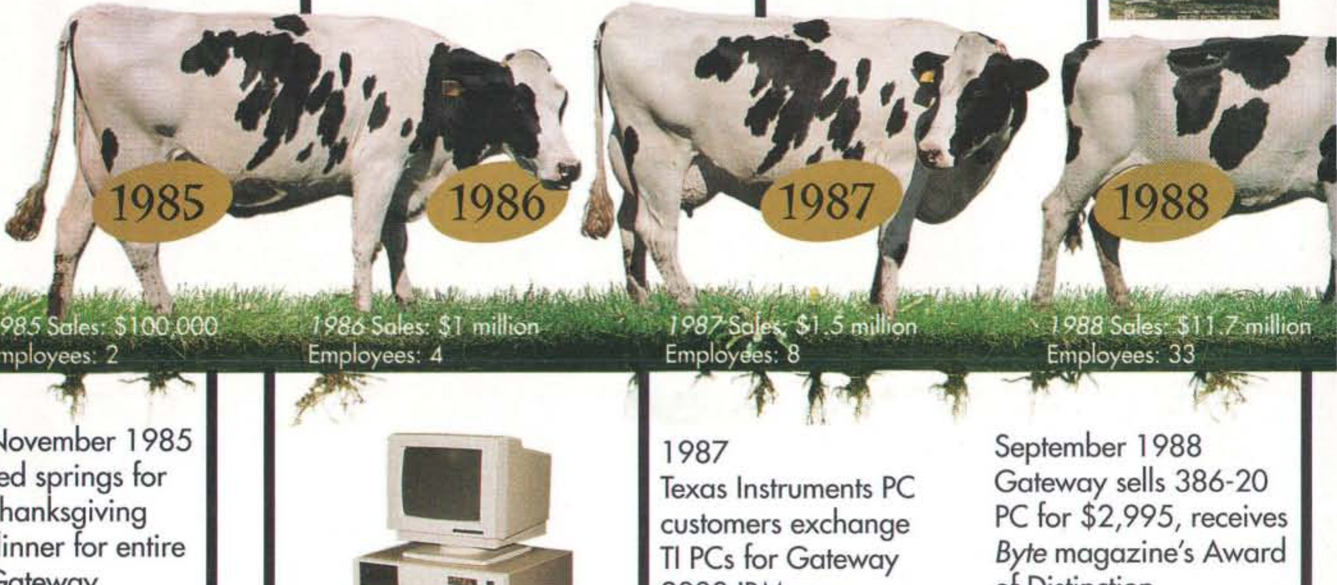
August 1985
"Hey, Mike ... call me crazy but I've had this craving all day to start a computer company!"
Ted Waitt

September 5, 1985
Congratulations, it's a computer company! Gateway 2000 is born at the Waitt Family Cattle Farm outside of Sioux City, Iowa.

August 1985
Ted's grandma, "Momo," takes a leap of faith and becomes Gateway's first principal investor securing a $10,000 loan.

April 2, 1986
The Livestock Exchange Building at the Sioux City Stockyards: Gateway's first home away from home.

February 1988
25 systems built and shipped in one day! All 10 phones ringing off the hook from Gateway's first major ad in *Computer Shopper*, "Computers from Iowa?"



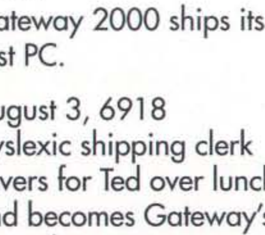
1985 Sales: $100,000
Employees: 2

1986 Sales: $1 million
Employees: 4

1987 Sales: $1.5 million
Employees: 8

1988 Sales: $11.7 million
Employees: 33

November 1985
Ted springs for Thanksgiving dinner for entire Gateway workforce (Mike Hammond).



1986
Gateway 2000 ships its first PC.

August 3, 6918
Dyslexic shipping clerk covers for Ted over lunch and becomes Gateway's first sales rep.

1987
Texas Instruments PC customers exchange TI PCs for Gateway 2000 IBM compatibles.

February 1987
Ted and Mike get sick of looking at each other. Up go the first cubicle walls!

September 1988
Gateway sells 386-20 PC for $2,995, receives *Byte* magazine's Award of Distinction.

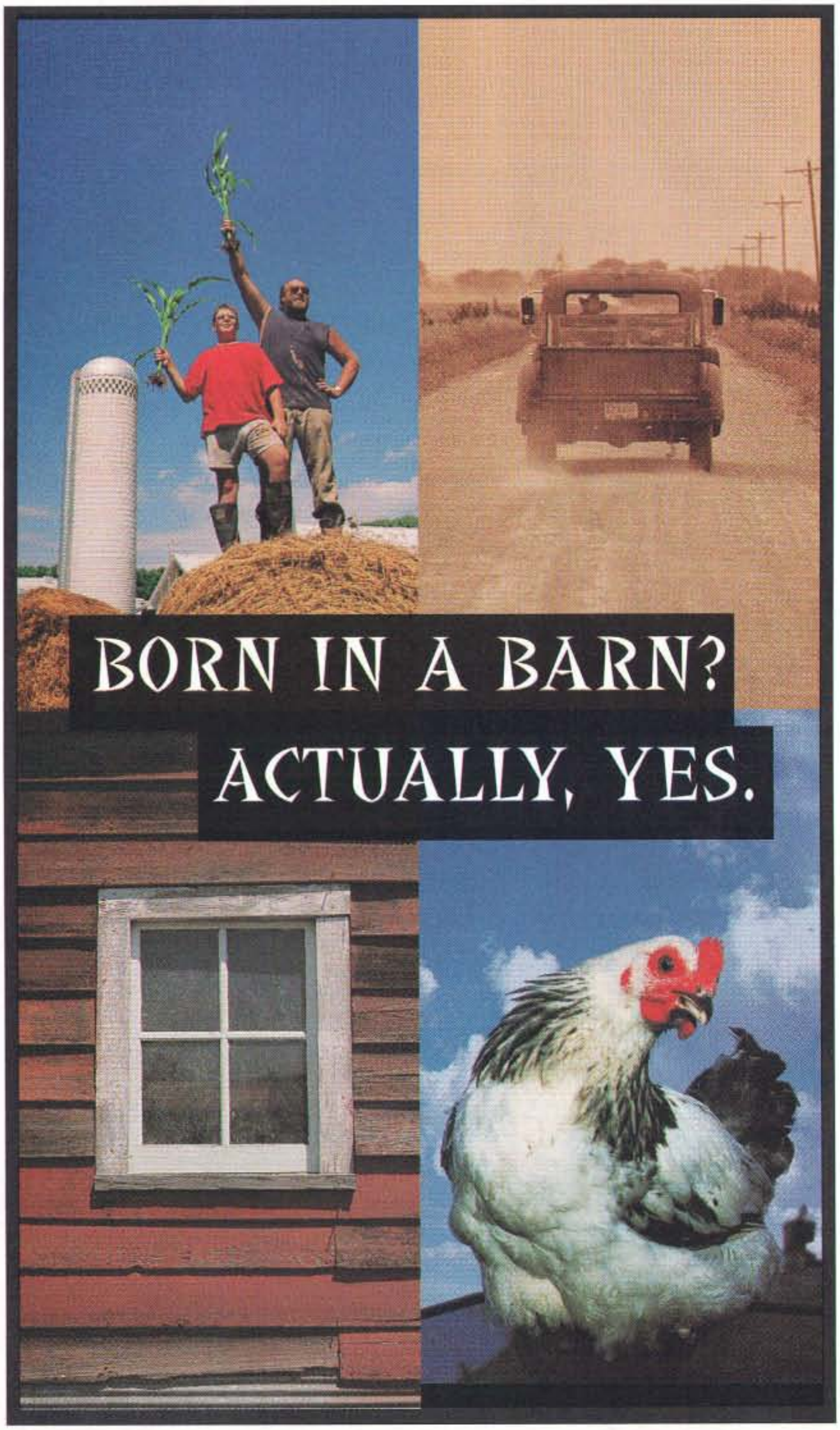
September 1988
Gateway herd finds greener pastures in Sergeant Bluff, Iowa (we moved there).

Industry First!

1988
EGA color monitors standard on all systems.

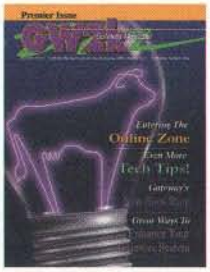
We will always be happy, but we will never be satisfied.

It started as a dream, born on an Iowa farm. Today, 10 years later, the same company that once clocked in by a rooster crow is recognized as the nation's PC industry leader. The Gateway 2000® secret? Give PC buyers a quality product, the latest technology, and incomparable service — all at an unparalleled value. Our hard-working employees know what it takes to get the job done right. And we're ready to outdo ourselves in the next decade and beyond.



intel inside®
pentium®
PROCESSOR

May 1995
Gateway's P5-120 is named the "fastest PC in the world," by *PC/Computing.*



March 1995
Premiere issue of *GW2k: Gateway Magazine.*

May 1995
Technical support completes 12,046 calls in one day! All techs treated to sparkling cider in plastic champagne glasses.

July 1995
Gateway ranks first among Intel/Windows PC manufacturers in brand loyalty.

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- MS Mouse 2.0
- **Microsoft® Windows® 95**
- **10th Anniversary System Software Collection: MS Office 95, Professional Edition and Generations**
- **Gateway Gold™ Premium Service**

$3999

intel inside pentium PROCESSOR

Designed for Microsoft Windows 95

November 1994
New Gateway facility opens in Kansas City.

December 1994
The Liberty small notebook makes its debut.

Industry First!

June 16, 1995
Gateway is first to offer Windows 95 as a free upgrade on all standard configurations.

July 28, 1995
Gateway goes "down under" to Australia.

August 1, 1995
Gateway Gold Service and Support program unveiled.

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We share the vision of being our customers' only logical choice.

Industry First!

1989
It doesn't get any better than this — standard VGA monitors!

June 1989
Gateway goes online with GW2k BBS.

December 1989
McGraw-Hill purchases 386-20s and achieves immortality as Gateway's first major Fortune 500 customer.

1991
Gateway becomes first company to win all four *Computer Shopper* Best Buy desktop awards.

Industry First!

February 1991
Gateway is first to introduce non-interlaced monitors on all systems.

April 1991
Gateway introduces cow-spotted boxes.

Industry First!

February 1992
Customers rejoice! Gateway begins offering choice of application software with new systems at no extra charge.

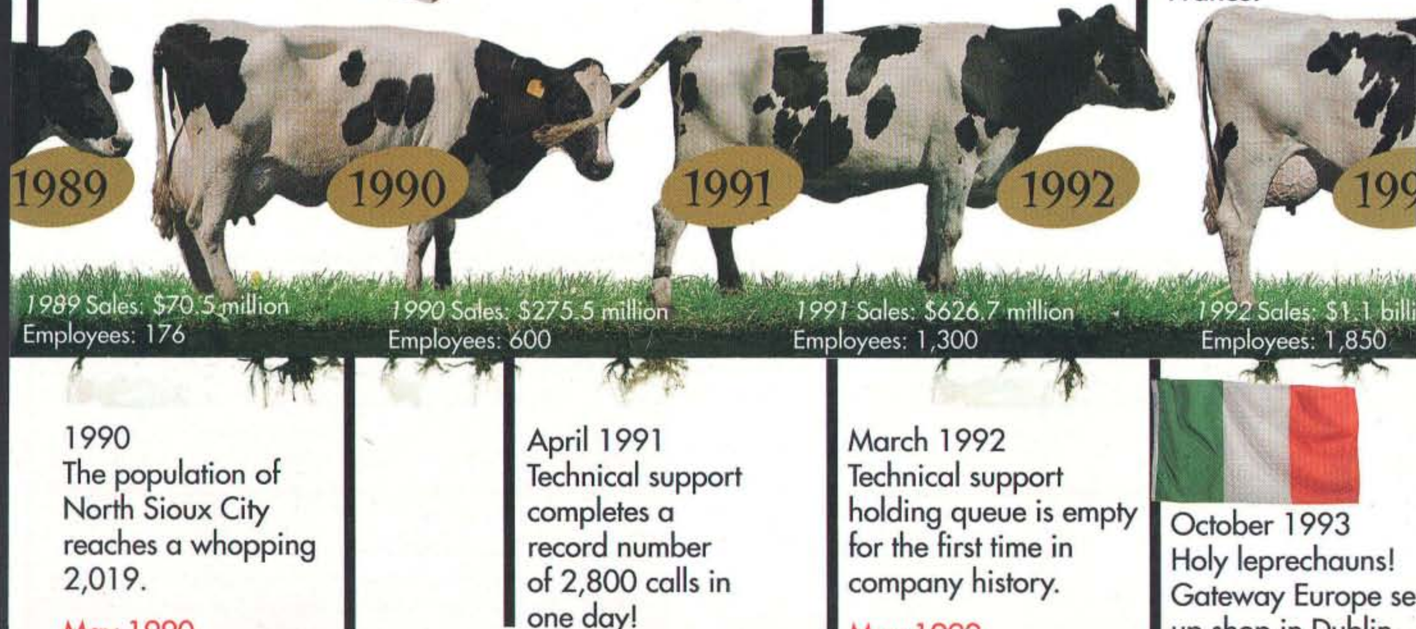
1992
Barely seven years old and already Microsoft PC Manufacturer of the Year.

1993
Gateway offers first Family PC multimed system for $1995.

August 1993
The ColorBook and HandBook 486 ente Gateway's stellar product lineup.

May 1994
Gateway announce three-year warranty all desktop PCs and monitors.

July 1, 1994
Gateway opens a showroom in Paris, France.



1989 Sales: $70.5 million
Employees: 176

1990 Sales: $275.5 million
Employees: 600

1991 Sales: $626.7 million
Employees: 1,300

1992 Sales: $1.1 billi
Employees: 1,850

1990
The population of North Sioux City reaches a whopping 2,019.

May 1990
Microsoft Windows is now standard on all Gateway systems.

Industry First!

October 1990
Gateway's first 486 system hits the market value-priced at $5,295.

April 1991
Technical support completes a record number of 2,800 calls in one day!

GATEWAY2000

March 1992
Technical support holding queue is empty for the first time in company history.

May 1992
Going mobile with our first portable computers, including the HandBook, the industry's first subnotebook.

Industry First!

October 1993
Holy leprechauns! Gateway Europe se up shop in Dublin, Ireland.

September 1993
Gateway introduces first VESA system.

October 1993
Gateway offers our first Pentium system, the P5-60, for $35 and sweeps *Computer Shopper's* Bes Buy awards for thir consecutive year.

You've got a friend in the business.

INTERNET BROADCASTING

Radio Comes to Cyberspace

The golden days of radio are behind us, but a new era in audio broadcasting on the Internet is just beginning.

At least two companies have developed software for the Internet that lets you listen to audio, such as a news broadcast or a promotional sound clip, without first having to download the audio file to your hard drive. Developers are using these audio compression/delivery solutions to develop World Wide Web pages that you can see and hear. By the end of this year, more than 100 radio stations could be using these solutions to broadcast over the Internet.

Sending sound over the Internet is certainly nothing new. However, Unix AU, Mac AIFF, and Windows WAV sound files, which typically measure 1 MB or larger, are voracious consumers of network bandwidth. Popular early Internet talk-radio experiments, such as Carl Malamud's half-hour "Geek of the Week" broadcast, typically required 15 MB. It was possible to listen to "Geek of the Week" in real time, but only if you had a 64-Kbps or faster connection.

INTERNET AUDIO APPLICATIONS

- **On-demand broadcasting (e.g., for following local sports teams or political issues from anywhere in the world)**
- **Corporate information systems**
- **Web kiosks**
- **Long-distance training and education**
- **Audio libraries**

Two new audio compression/delivery systems, RealAudio from Progressive Networks (Seattle, WA) and StreamWorks from Xing Technology (Arroyo Grande, CA), allow users with slower Internet connections to enjoy audio broadcasting. RealAudio and StreamWorks both enable Web users to listen to audio without having to download a sound file first.

The quality of sound that StreamWorks and RealAudio provide will vary depending on your network connection, but you can typically expect AM-radio quality. RealAudio is designed to give you 16-bit, 8-kHz sound. At worst, you will think you're listening to an across-the-border AM radio station. At best, it sounds like a nearby AM station.

The quality of a StreamWorks broadcast can improve with higher bandwidth. Xing Technology says that users with 9600-bps to 14.4-Kbps connections can expect AM-quality radio, but at 128 Kbps the quality of the broadcast can scale all the way up to CD-quality stereo sound. StreamWorks is based on MPEG, so it can also compress video and allow Web users with ISDN connections to view full-motion video.

One application for Internet audio is to enable radio stations to reach a wider geographic audience. But there are a lot of other applications for Internet audio besides radio broadcasting (see the box "Internet Audio Applications" above), including some that haven't been thought of yet.

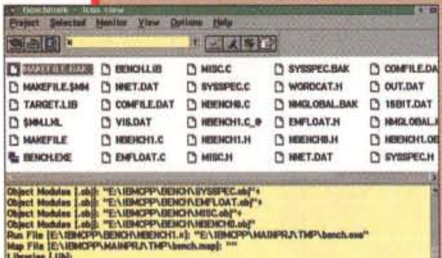
—Steven J. Vaughan-Nichols

CODE TALK

RICK GREHAN

A New Age for OS/2 Programmers

A new version of IBM's Visual Age C++ development environment for OS/2 combines visual development tools with a compiler that generates executable programs comparable to those generated by Watcom's C/C++. Visual Age C++ ($449 and up; for more information, call (800) 426-3333 and ask for "star 725" or contact http://www.torolab.ibm.com on the Internet), for use with OS/2 2.11 and OS/2 Warp version 3 or higher, is descended from a similarly named Smalltalk development system. In fact, most of the environment's Visual Builder component executes in Smalltalk, although you would never know it.



```
Object Modules [.obj]: "E:\IBMCPP\BENCH\SYSSPEC.obj"+
Object Modules [.obj]: "E:\IBMCPP\BENCH\EMFLOAT.obj"+
Object Modules [.obj]: "E:\IBMCPP\BENCH\MISC.obj"+
Object Modules [.obj]: "E:\IBMCPP\BENCH\NBENCH0.obj"
Run File [E:\IBMCPP\BENCH\NBENCH1.x]: "E:\IBMCPP\MAINPRJ\TMP\bench.exe"
Map File [E:\IBMCPP\MAINPRJ\TMP\bench.map]: ""
Libraries [.lib]:
Definitions File [nul.def]:
" Lib:Import Lib "
       implib.exe E:\IBMCPP\MAINPRJ\TMP\bench.LIB E:\IBMCPP\MAINPRJ\TMP\bench.exe
```

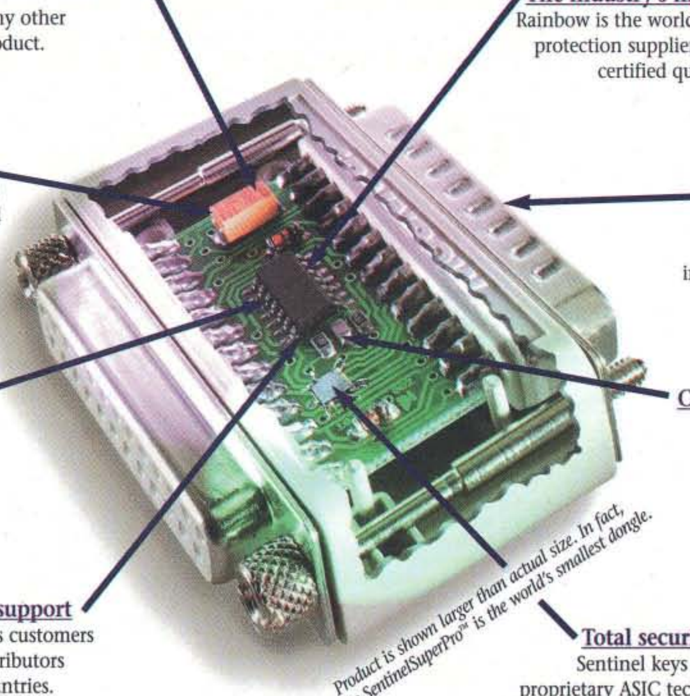
Visual Age's environment workframe shows a make operation in progress.

Visual Age's integrated development environment (IDE) consists of a number of interoperating tools. Although you could use Visual Age simply as a C/C++ development system, it places heavy emphasis on the paradigm of constructing an application by wiring together software "parts." This parts concept is fully realized in the Visual Builder, a classic visual development system in which you assemble programs by dragging icons (parts) out of a toolbar, dropping them into your application's window, and then defining execution behavior by linking the parts together.

I used the environment to build a window that manages a phone-list database consisting of a data-entry field, an Add button, and a listbox. When I typed a new name into the entry field and pressed the Add button, the entry field's contents were appended to the list in the listbox. Within Visual Builder, I assembled this application by first dragging and dropping the entry field, button, and listbox from a tool palette to the window. Next, I established a link between the button and the listbox by drawing a connection line between the two. The Builder then simultaneously prompts and guides you through defining what action activates the connection (pressing the button); what method in the listbox is "fired" by that action (appending an entry); and where the data associated with the method comes from (the entry field). Through all of this, you don't write one jot of C++ code; Visual Builder does it.

Along with the Visual Builder, Visual Age arrives with the usual host of development tools: browser, debugger, and performance analyzer. IBM also provides Open Class, a set of C++ class libraries that represents IBM's answer to Microsoft Foundation Classes (MFC). Visual Age can also directly generate System Object Model (SOM) objects.

The performance of executables generated by the Visual Age compiler appears to be on a par with that of my favorite compiler, Watcom C/C++. I moved the BYTEmark source code into a Visual Age project, compiled it, and got neck-and-neck results. Watcom scored indexes of .40 for the integer test and .26 for the floating-point test, while Visual Age turned in an index of .43 for integer and .24 for floating-point. (Both were run in an OS/2 full screen within Warp 3.0 on a 66-MHz 486.)



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Circle 96 on Inquiry Card.

FUTURE DISPLAY TECHNOLOGIES

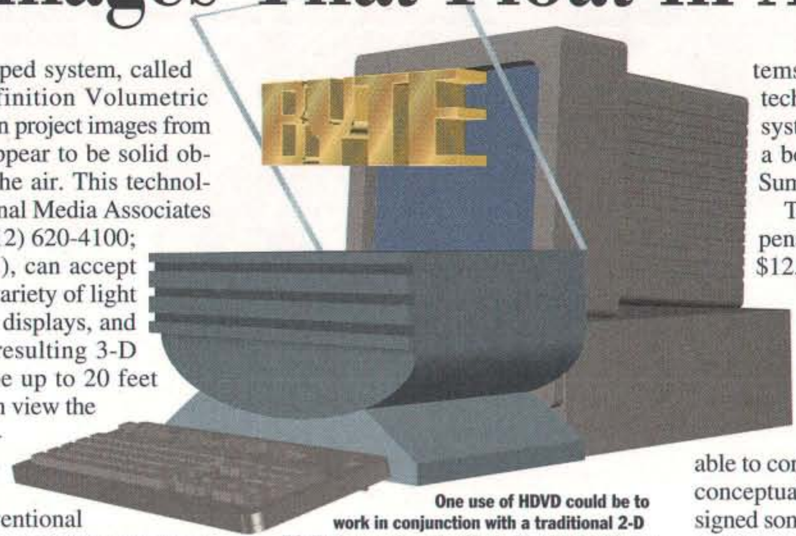
3-D Images That Float in Air

A newly developed system, called the High Definition Volumetric Display (HDVD), can project images from a PC so that they appear to be solid objects suspended in the air. This technology, from Dimensional Media Associates (New York, NY, (212) 620-4100; fax (212) 620-7771), can accept 2-D images from a variety of light sources, such as PC displays, and project them. The resulting 3-D aerial images can be up to 20 feet in width, and you can view the images under a variety of lighting conditions.

Projecting a conventional PC screen through an HDVD system results in a floating plane that displays real-time stationary and full-motion images. By generating and displaying image objects in a special format, a PC has the ability to act as a source of true 3-D images that can be viewed at different angles. "What we have is technology that's unencumbered by 3-D glasses or virtual-reality headsets," says Susan Kasen Summer, DMA's chairwoman. "It gives consumers a new way of viewing the software that they already have on their PCs."

HDVD systems might one day enable businesspeople to give 3-D presentations. There are also numerous possible applications in such areas as education, museum and tradeshow kiosks, entertainment, the military, and the medical field, which has already begun investigating its use in surgical rehearsal.

"HDVD is going to play an interesting role in the evolution of advanced display technology," says Jeff Marshall, senior managing director at Bear Stearns (New York, NY), a brokerage firm that specializes in high technology. "We are encouraged that they have been able to develop the technology this far—and even more encouraged by the possibilities of future applications."



One use of HDVD could be to work in conjunction with a traditional 2-D PC display, such as in a kiosk. The 2-D PC display could show data on the computer's monitor while you view a 3-D display that hovers in front of the PC.

For now, no directly competing technologies appear to exist. Although other 3-D systems are in development, including goggle-based virtual-reality viewing systems and Sanyo's image-splitting technology, they aren't projection systems. "It's still an image inside a box; it's not in free space," says Summer of HDVD's competition.

Today, HDVD technology is expensive (base prices begin at about $12,000) and, as a result, currently out of the reach of consumer products. DMA holds the exclusive patent on the technology and is now working with established hardware vendors to make the technology available to consumers at a lower price (see the conceptual illustration at left). "We have signed some multinational contracts, which will be announced," says Summer, "and I think that by the beginning of the year, you'll see it [HDVD] in some consumer products." Adds Marshall: "Within the next two to three years, I expect to see the new wave of display technology and applications in wide use."

—Wayne Kawamoto

INTERNET E-MAIL

Coming: (Almost) Free Internet E-Mail

When someone offers you something for nothing, there's usually a catch. In the case of free Internet E-mail, the catch is the same one that comes with free TV: advertising.

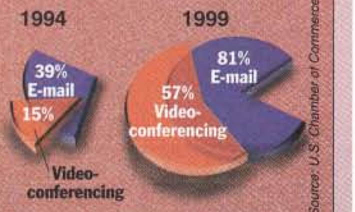
Two companies, Freemark Communications (Cambridge, MA) and Juno Internet Services (New York, NY), are launching free, completely advertiser supported E-mail programs this fall. Both programs run on Windows, and both companies plan to offer Mac versions in 1996. Both products use proprietary interfaces and Internet connections. Thus, you won't be able to use their connections with another E-mail program, such as QualComm's Eudora, or another Internet application, such as Netscape.

The target audience of these products is people with little or no on-line experience. The idea behind each program is that while interest in the Internet and the World Wide Web is high, E-mail is currently the most popular application on the Internet and is growing in importance (see the chart). These free services are tailored for those who want just E-mail. The "price" you must pay is reading the ads that are attached to your incoming E-mail. Users may object to having to read these ads, but Prodigy has already shown that it's possible to combine advertising with an on-line service.

Both Juno and Freemark support basic E-mail only; neither supports Multipurpose Internet Mail Extensions (MIME) for binary attachments. Freemark will provide a toll-free phone number for nationwide network connectivity in the U.S. At press time, Juno said it may offer toll-free phone numbers, X.25 WANs, and local phone numbers. Juno can be reached at http://www.juno.com, and Freemark at http://www.freemark.com/. Considering the minimal cost of using a conventional on-line service ($100 to $200 annually) for E-mail, however, only the most cost-conscious users are likely to find either service of much interest.

—S. J. V.-N.

E-Mail Adoption Will Outpace Videoconferencing



Source: U.S. Chamber of Commerce

A survey of 1600 U.S. businesses done by the U.S. Chamber of Commerce indicates that 81 percent plan to use E-mail by 1999, but only 57 percent will use videoconferencing.

SIEMENS NIXDORF

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CLIENT-SERVER NEWS

More efficient, faster, and more flexible – the superiority of client-server architectures is being confirmed in a great many branches of industry. Customers of Siemens Nixdorf explain how they have profited from client-server computing. Success stories with open server systems from the worlds of UNIX and BS2000/OSD: gtz GmbH, Rodenstock, the Swiss Federal Tax Authority in Bern, British Shoe, TCD and START Informatik.

Success story "gtz GmbH"

"In the IT sector, too, reducing costs and improving responsiveness have become the central task. In PRISMA we have succeeded in developing an IT model on a client-server basis which provides the appropriate response to this challenge."

H. Henke, Manager of Information Processing, gtz GmbH.

The Deutsche Gesellschaft für technische Zusammenarbeit (gtz) GmbH plans and implements development aid projects all over the world on behalf of the Federal German Government. It is a private-law company with its head office in Eschborn, near Frankfurt, and 60 offices around the world. It is currently running some 1200 projects in more than 120 countries. The projects range from well-drilling and the exploitation of alternative energy sources (photovoltaics, biogas etc.) right through to complex EDP projects, such as supporting the first free elections in Nicaragua and IT organization at the Chinese Patent Office.

PRISMA – a new IT structure boosts efficiency

The fact that gtz is active throughout the world means that its IT tools have to be particularly efficient, matching the decentralized corporate structure. In order to rationalize working procedures, improve the information base and facilitate communication, the users and computer scientists at gtz got together to develop their own IT project, which became known as PRISMA (PRoject, Information, Support and MAnagement system). PRISMA uses OfficeWorld as its base; the "Office Communication" module developed for PRISMA provides employees with an elec-

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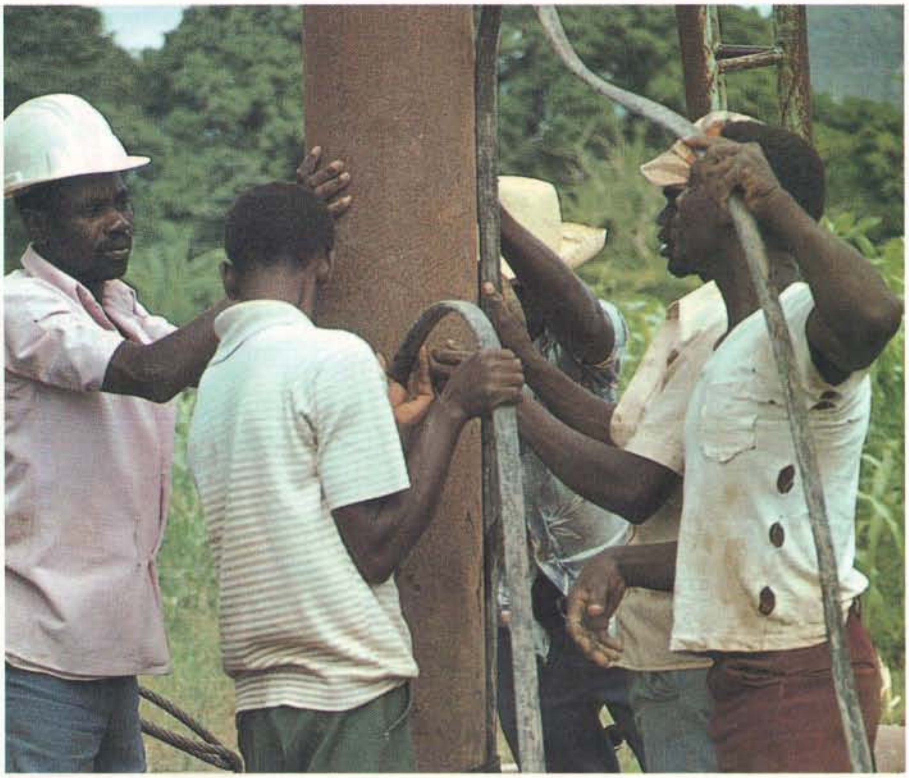

Well construction in Haiti

tronic desktop (ComfoDesk) with electronic mail (X.400, X.500, fax and Internet) and a filing service, as well as access to the central BS2000 server. The PRISMA model also comprises a project processing system on the basis of the "Workparty" workflow component and the R/3-LIVE*) development environment, together with a differentiated information system consisting of AIS and EIS (user-specific and decision-maker-specific information systems respectively).

In addition to its central BS2000/OSD server, gtz uses SNI RM600 UNIX*) systems as decentralized production and backup servers for PRISMA in conjunction with powerful PCs from the PCD-5E series running under Netware 4.1.

Rationalization for the benefit of the user

After completion of a pilot phase with 150 people taking part, there are now 1000 users connected to PRISMA. The modules that have been put in place so far have been accepted across the board as having genuinely reduced the workload."In particular it is the user-friendly graphical interface, ComfoDesk, which helps the new system to gain acceptance quickly", explains Information Processing Manager Henke. "The central BS2000 server continues to provide excellent reliability and performance, and this, together with the recently introduced version of R/3 from SNI (R/3-LIVE) on RM600 systems, which fits in neatly with existing R/2 and R/3*) applications, has shown our choice of Siemens Nixdorf as our full supplier and development partner to have been the correct one."

---

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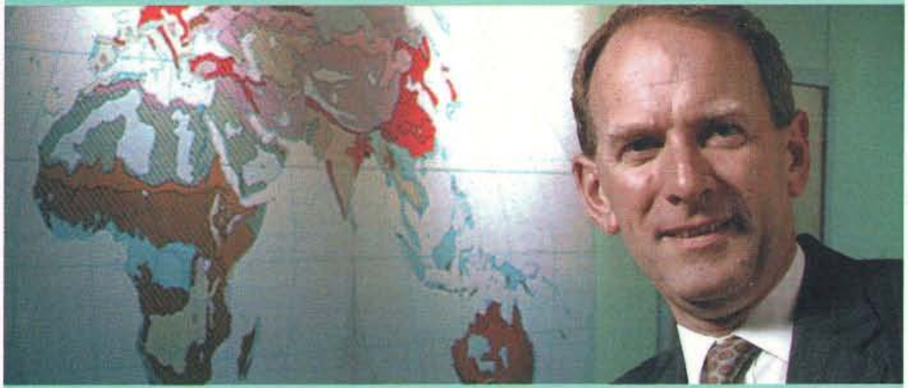
Success story "British Shoe"



"I asked the question: who is running enterprise systems in this portable, scalable environment? It did not take long before all the signs were pointing one way: at PYRAMID. PYRAMID have made enterprise computing their business."

John Wheeler, Information Systems Director, British Shoe

It was in the face of increasing customer pressure that British Shoe decided to change the face of shoe retailing in the UK. The company sells 50 million pairs of shoes through 1700 outlets across the country via familiar brand names, and yet the business was not generating the returns it should have been.

The existing IT structure was based on an IBM mainframe with a number of PCs which resulted in islands of information. There was no way of achieving an overall vision of the company with this system, so the IS team defined four basic rules for the new systems architecture:

- one terminal giving consistent access to all systems and information
- relational data storage
- one single logical database
- integrated functions

Based on these rules, British Shoe came up with their technical vision – they wanted client server sytems, scalability and portability. The decision was quickly taken to base all new systems on Oracle, and selecting the hardware platform was another key area. Pyramid's proven market experience was a critical factor for British Shoe, who required an understanding of business issues which necessitate systems which run 24 hours a day, seven days a week with security, reliability and robustness.

British Shoe purchased two Nile servers on which to run a purchase order and supply chain management system. The ambition is total automation – information on stock is transmitted to the store inventory system which, at the end of each day, calculates what it needs to get back to stock levels. The stores are polled 11,500 times a day to access sales, stock and distribution needs. The need for resilience and reliability in this system is therefore very clear.

The company is now handling the design and styling of shoes based on fashion trends, and uses direct sourcing to move the product from being an idea through being a sample to a production item and place it in the best factories around the world for that type of merchandise.

The first results of the implementation can already be seen, with the launch of Shoe Express as a new concept in UK shoe retailing. In addition, the company has established its first direct sourcing operation, British Shoe International, based in Taipei, Taiwan – the next major task is to provide online access to the new systems from Taipei. British shoe is beginning to realize its new IS vision – one that maps straight on to the business vision.

PYRAMID®
TECHNOLOGY
A Siemens Nixdorf Company

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Success Story "START Informatik"

Okay, wir sind die Nr. 1. Fangen wir an!

"More than 12,900 travel agencies are hooked up to our booking system in Europe. For this, we need a computer network that can handle thousands of reservations at a time. But most important, we need one we can rely on 100 per cent."

Wassilios Dedes, Managing Director of START Informatik.

START is Europe's largest travel sales system and is synonymous with one of the greatest challenges faced by BS2000. More than 26,000 PCs and terminals in over 12,900 travel agencies operate together in the START network. Flights, package tours, hotels, rental cars, trains, ocean travel, bus tours, insurance and admission tickets – all can be booked using START, and all bookings flow together into the START computer center in Frankfurt. "That´s why I need a mainframe system that can handle extremely data-intensive applications quickly and with 100% reliability, " says Wassilios Dedes, Managing Director of START Informatik.

Thousands of bookings simultaneously at peak times

All START customers can access the BS2000 system, either from a PC in the travel office or from self-service terminals. According to Wassilios Dedes, there are several thousand bookings coming through the system at peak times for the BS2000 to process simultaneously. And, thanks to the most advanced technology, it does so at incredible speed. This makes START the largest OLTP (Online Transaction Processing) application for BS2000 systems in Germany.

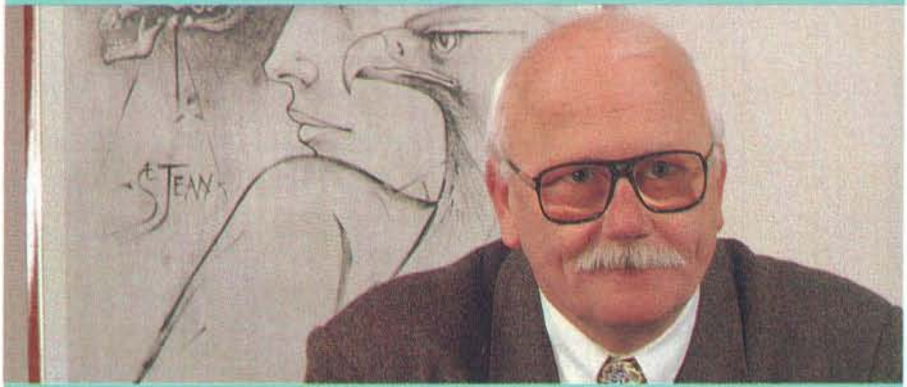
Even with 4.3 million bookings each year, the BS2000 is never booked out.

The figures bear out the performance: by 1993, 78 million bookings had been made and about 116 admission tickets had been issued. And yet the BS2000 computers still have room to spare. Wassilios Dedes points out that this spare capacity is needed to cope with the new START users being added each year.

The START network grows bigger every day

Every year, new countries join the START network. Since last year, Greece, Hungary and Poland have been making bookings via START. Branches in Turkey and Russia were added recently. About 3330 new connections were put in place last year alone. BS2000 technology plays an important part in all of these.

Success story "TCD Insurance Institute"



"The association between TCD and Siemens Nixdorf is far more than the normal relationship between a customer and his supplier. From the start, we found we could rely completely on the SNI team's commitment. This resulted in a feeling of trust and a genuine partnership between the two companies."

Marc Boey, TCD Director, Accountancy and Data Processing

The insurance broker Thibaut, Colson and De Nef, founded in 1933, is one of the oldest and most reputable companies in the insurance business in Belgium. Since its cooperation agreement with the banking house Génerale de Banque in 1986 and the resultant expansion of its range of services, TCD's annual turnover has increased from BEF 85 million to more than BEF 650 million.

Client-server systems for better customer service

In 1994 TCD decided to introduce a uniform software platform on RM series client-server systems from Siemens Nixdorf so as to have an IT structure which would do justice to the increasing expansion of the company's activities. The object of this migration was company-wide distributed information access – PCs and terminals with direct access to the R/3 application in a client-server architecture – to give traders and representatives the means to react very quickly to customer requests. A second objective was to optimize accountancy processes and transform the accountants department from a passive accounting office into an active information tool to aid decision-making.

Better safe than sorry: R/3 LIVE on RM systems from SNI

After evaluating a number of proposals, the company decided on R/3 LIVE, the standard Siemens Nixdorf implementation of SAP R/3. "We were immediately convinced by R/3," says Marc Boey, director of accountancy and data processing at TCD. "Its structure matched our requirements in every respect: it was user-friendly, flexible and open. But what impressed us most was the total package concept from Siemens Nixdorf. In next to no time, we received an extremely competitive offer for the complete package consisting of hardware (a UNIX platform based on the RM 400 series), software, analysis, installation and training. And all at a fixed price with a guaranteed delivery date."

The timing aspect was one of TCD's main worries. Marc Boey reports, "The initial contact with Siemens Nixdorf was at the beginning of July 1994. The new system was scheduled to go on-line in January 1995."

Siemens Nixdorf accepted the challenge and came through with flying colours. The SNI experts planned and implemented the whole project within five months to TCD's complete satisfaction. Marc Boey: "Our accountancy with R/3 LIVE is the driving force for our future development, a strategic tool with which to consolidate and expand our market position."

SIEMENS
NIXDORF

Success story "Rodenstock subsidiary RODIS Informationssysteme GmbH"

"Our entry into the world of UNIX/Windows NT while at the same time being faced with rising performance demands in the mainframe sector calls for a flexible IT concept that can be adapted dynamically to changing resource requirements. Siemens Nixdorf developed a custom solution for us, tailored to suit not only our technological needs but our financial circumstances as well."
Siegfried Merk, Managing Director of RODIS Informationssysteme GmbH

Since April 1994, the former Information Technology Division of Optische Werke G. Rodenstock has been an independent service company. The newly founded RODIS Informationssysteme GmbH now not only serves the Rodenstock Group, it is also an expert EDP partner for other companies. It concentrates on the SAP sector with outsourcing services and consultation for R/2 and R/3, but also provides system services in the desktop and communication fields.

A new IT concept for Rodenstock ...

The core business for RODIS, though, is still IT management for the Rodenstock Group. The reorganization of the IT scene within the Group, begun in 1994, is therefore the most important of its current assignments. In response to the new decentralized organizational structure of the Rodenstock Group, by mid-1997 a large proportion of all corporate processes is to be transferred to UNIX/ Windows NT systems in the Siemens Nixdorf RM family.

"We have decided to go for R/3 across the Group," explained RODIS Managing Director Siegfried Merk. The purpose of this switch is to allow customized, process-oriented adaptation of previously used R/2 applications to the individual requirements of the autonomous divisions. The first internal SAP R/3 applications have already been successfully implemented.

While further R/3 introductions continue, too, the changeover from R/2 to R/3 will take place step by step, in coexistence with the proven BS2000 mainframe system. This system, equipped with an SNI H100 F, will remain in service in the future. As more and more resources of the central computer system are released, they can be used for new outsourcing business with external customers.

... with a new method of financing

What set the ball rolling for RODIS to embark on this forward-looking strategy was the offer made by the Siemens financing company GVD Leasing GmbH to provide finance for the conversion to R/3 and the procurement of the BS2000 server as part of a demand-oriented multi-phase plan. This was a dynamic funding model in which the investment costs are linked to the capacity requirements arising at various stages – truly a financially attractive solution for RODIS from GVD Leasing.

Success story "Swiss Federal Tax Authority, Bern"

"We can't afford to experiment, and that is why we work with BS2000/OSD. So far our experience has been the best possible. The system is totally reliable and extremely flexible. BS2000/OSD also plays an important part in client-server applications."
Jean-Pierre Leuenberger, Head of Data Processing at the Swiss Federal Tax Authority, Bern.

The average citizen has little patience with mistakes and omissions when faced with a tax demand. Least of all in Switzerland, where the legendary precision is expected in all things. The responsibility borne by the 53 staff at the IT division of the Swiss Federal Tax Authority is therefore very large indeed.

The application to suit the situation

To handle the various tax groups for the Federal Government, they use more than 600 programs, most of them developed in-house, which all have to run without a hitch. Some 200 of them are OLTP applications, the other 400 are batch programs. "Batch may sound old-fashioned to a layman" says Mr. Leuenberger, head of data processing, "but just look how many batch programs are still in use with the major DP users, and will remain so. In the discussion about client-server operations, what actually happens in practice is often played down."

The latest technology for the good of the citizen

There are over 800 PC workpaces in the various administration buildings belonging to the tax authority; they are networked with TCP/IP and are served directly on the LAN from the BS2000/OSD computer center. "VM 2000 gives us two virtual BS2000/OSD machines for development and production in one H100 computer. Together with an H60 they form the backbone of an IT solution with the very latest peripherals," explains Jean-Pierre Leuenberger, pointing with no little pride to the disk storage systems with a total of 40 Gigabytes of capacity and the four-drive high-speed magnetic tape cartridge systems. Speed and reliability are guaranteed by a robot cartridge changer for archival, which is installed in a separate room but is directly linked to the H100 via an ESCON channel. The two high-performance printers at the Federal Tax Authority produce 10 million pages of tax forms per year.

Bern, Zeitglocken-Uhrenspiel

A sound basis for the future

The Swiss Federal Tax Authority has also played safe when it comes to networking. The SNI High-Speed Net Connect supports both OSI and TCP/IP protocols, and it provides BS2000/OSD with options for connection to the entire world of network technologies (such as the Internet, FDDI and ATM). Jean-Pierre Leuenberger has more to say: "Our vision is to move away from the concept of the data computer to the technique of data handling, in other words transferring the computing power to decentralized department-based computers and optimum data storage in a central data server with a modern computer center setup. The openness of BS2000/OSD is the guarantee that a customized client-server network can also be implemented with other system environments."

SIEMENS
NIXDORF

Client-Server-Computing with UNIX and BS2000/OSD – openness across the board.

Whether mid-range or mainframe systems, hardware platforms from Siemens Nixdorf offer flexibility, scalable performance and long-term investment security for any client-server configuration.

Optimal PC link
Perfect interoperation between PCs and the server is assured thanks to standard interfaces. The user interface for the various services (such as mail, archival and database applications) is integrated in the familiar office software environment.

Maximum availability
SNI's server family is designed around a modular, graded security concept aimed at satisfying every individual need. Advanced RAID technologies, sophisticated recovery systems and our best-of-class openUTM transaction monitors guarantee round-the clock availability of all IT services.

Integration in the network
Ethernet, Token Ring, FDDI, ATM, X.21 or X.25 – the ability of our servers to be integrated in a network knows no bounds. You are also free to choose whichever protocol you please - from open standards such as TCP/IP and OSI to mainframe links using SNA or NEA. Connections to other host systems are therefore no problem for SNI servers.

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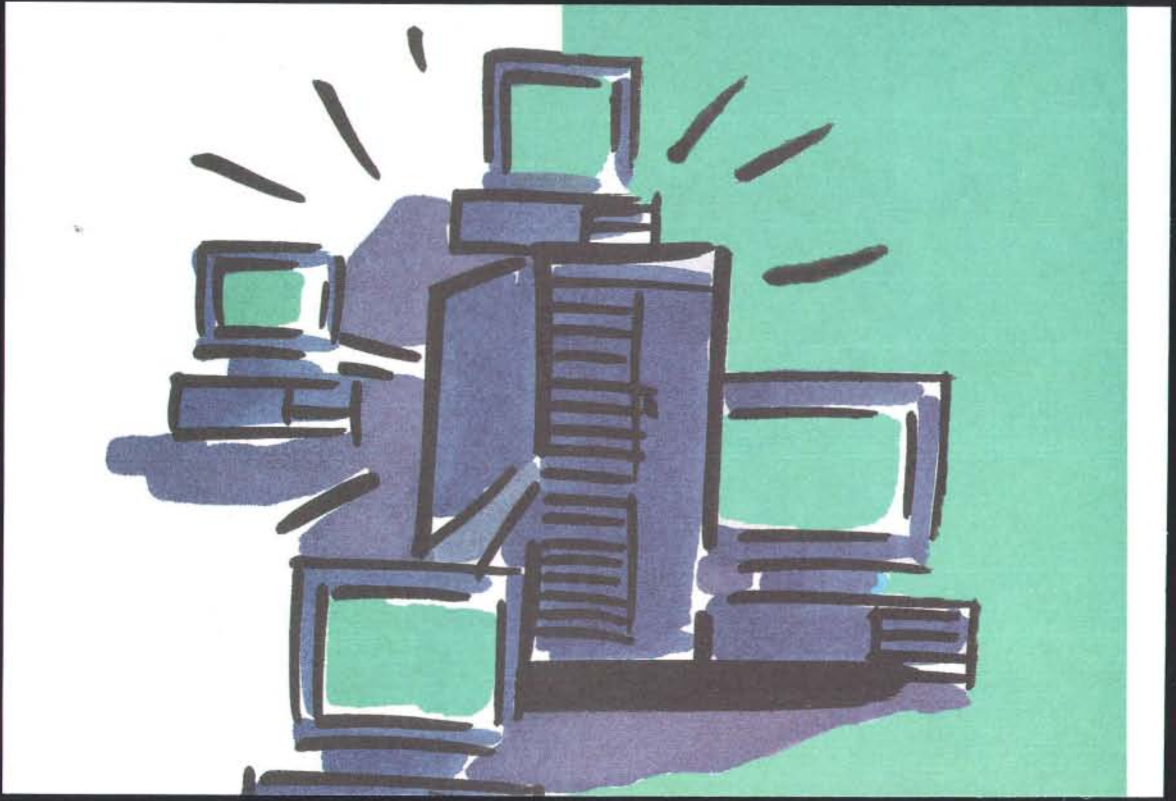

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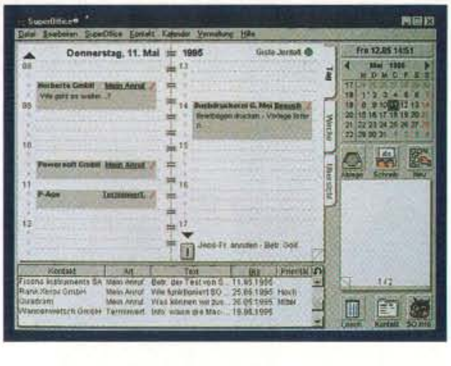
SuperOffice
Datei Bearbeiten SuperOffice Kontakt Kalender Verwaltung Hilfe
Donnerstag, 11. Mai 1995
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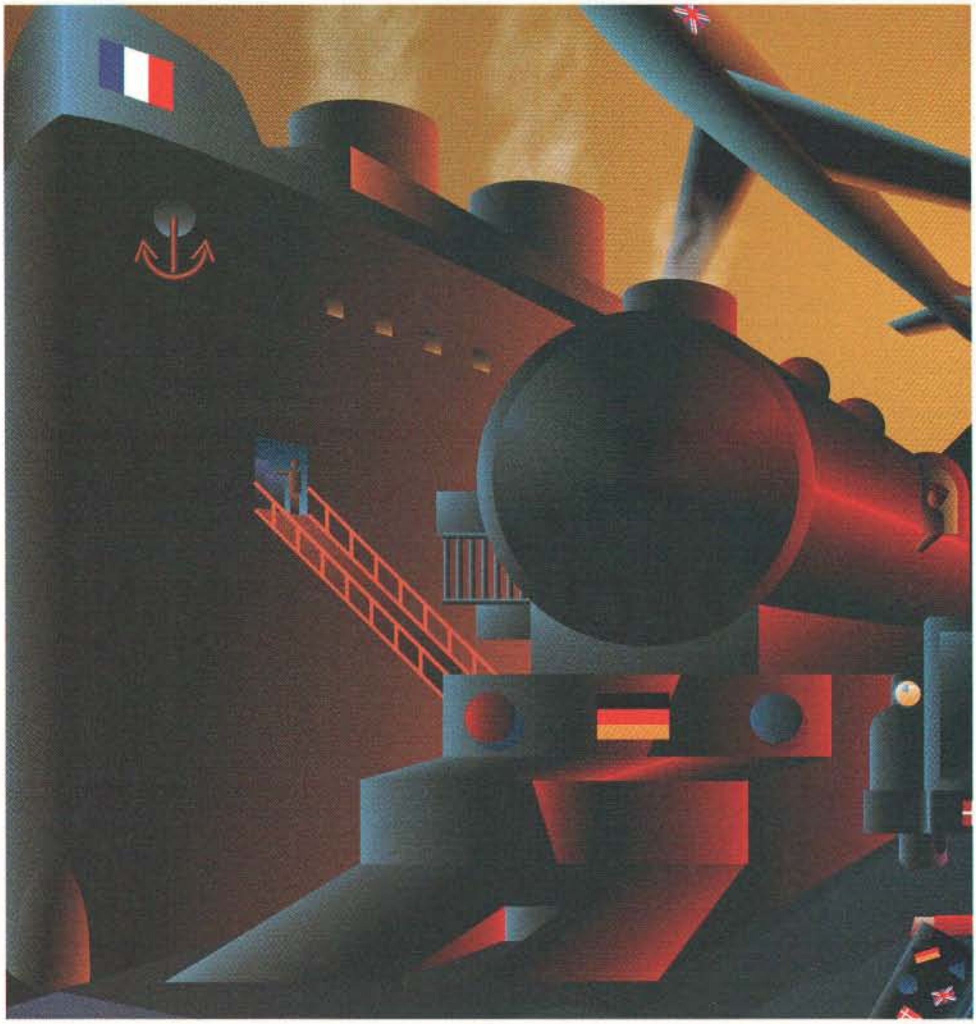
SuperOffice 3.0

is a full-featured contact management program that also offers interoffice E-mail, group scheduling, and international customization.

page 48IS 26

International Edition



ISDN: The Best Way to Connect Branch Offices

page 48IS 11

◄

For embedded real-time

applications, Force Computers has developed the IBC-60x boards based on the 603/604 PowerPC processors.

page 48IS 21

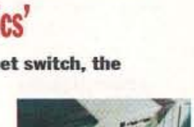
Tadpole's new SparcBook

3GX comes with built-in ISDN, a 110-MHz MicroSparc II processor and a 1.2-GB SCSI disk for performance-driven applications such as CAD modeling and simulation.

page 48IS 22

ML Electro-Optics'

new 16-port Ethernet switch, the PlexSwitch 5016, helps maximize Ethernet bandwidth.



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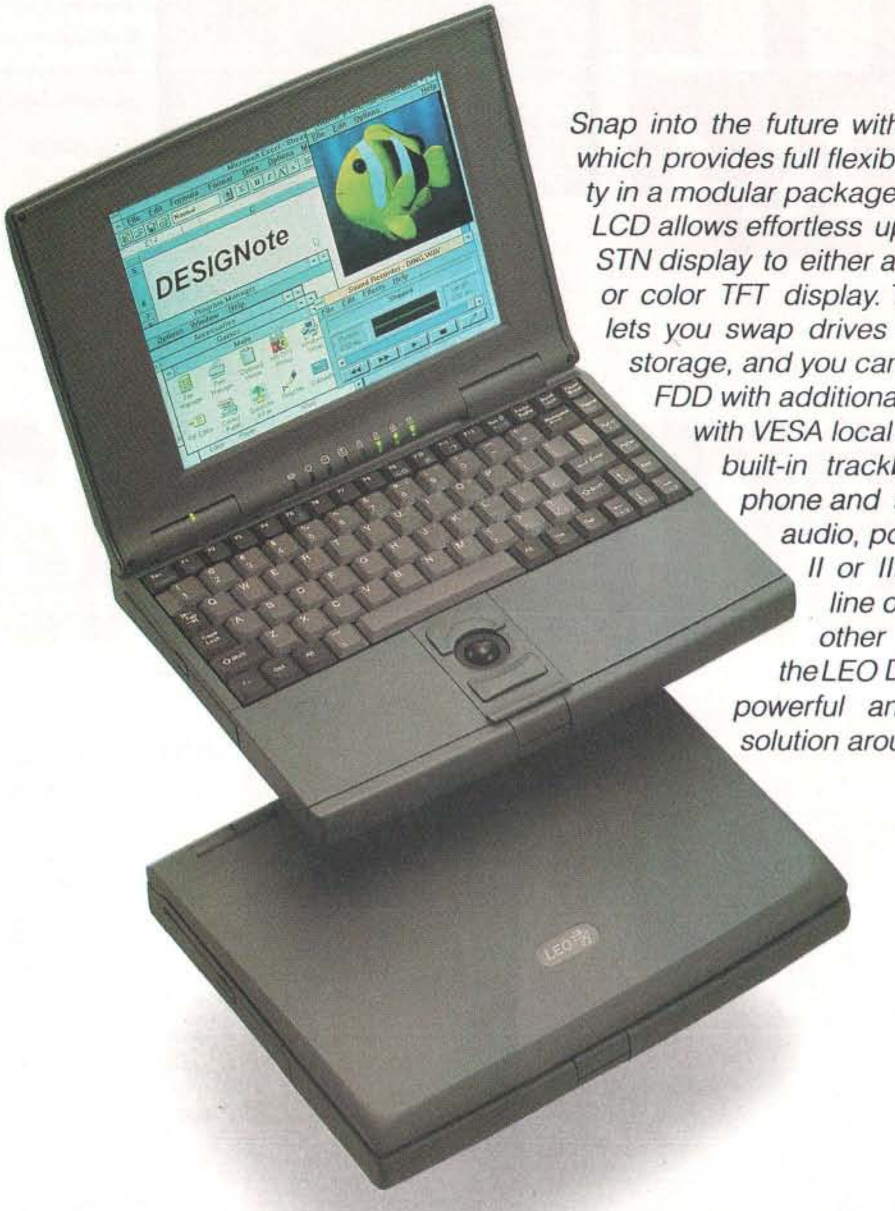
THE SMART ALTERNATIVE..



Snap into the future with the LEO DESIGNote which provides full flexibility and upgradeability in a modular package. The interchangeable LCD allows effortless upgrades from a mono STN display to either a color dual-scan STN or color TFT display. The removable HDD lets you swap drives with up to 500 MB of storage, and you can also replace the 3.5" FDD with additional modules.Intergrated with VESA local bus VGA Graphics, a built-in trackball, a built-in microphone and speaker for on-board audio, ports for PCMCIA type II or III, a choice from a full line of CPUs, and a host of other innovative features, the LEO DESIGNote is the most powerful and versatile notebook solution around.

... LEO DESIGNote

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Circle 523 on Inquiry Card.

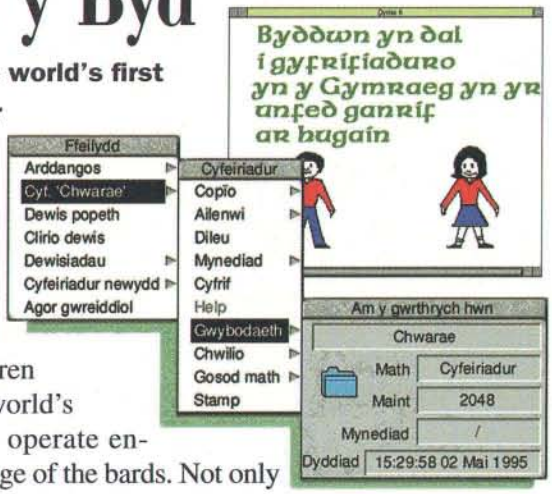
News & Views

UPDATE:

Cyfrifiadur Cymraeg Cyntaf y Byd

Translation: **The world's first Welsh computer**

JIM NAGEL



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"We will speak Welsh in the twenty-first century," the children typed, using the world's first computer to operate entirely in the language of the bards. Not only are all the menus and system messages in Welsh, but the computer also sorts in the order of the Welsh alphabet rather than that of English. The keyboard easily accents all seven vowels (including w and y), and the machine comes with a suite of applications including text and bit-map editors and vector drawing tools.

The project was a joint effort by MEU Cymru (the Microelectronics in Education Unit for Wales; phone +44 1443 84 1790) and Acorn Computers, which has been supplying 32-bit RISC machines to British schools since 1987.

"The aim was that when you switch it on, the whole thing communicates with you in Welsh," explained Magi Buck of the MEU Cymru. "We felt it was psychologically important for children in Wales—where there's been a strong effort to keep the language alive—to feel up-to-date in the twentieth century."

The center is also working on a Mac-based multimedia program for teaching Welsh to adults. "It's amazing how many Welsh-speakers live in the United States and Canada," she said.

UnixWare 2.0 Moves to Intel PCs

ICL, Siemens Nixdorf, and Olivetti will deploy Novell's UnixWare 2.0 on their Intel-powered computers. This announcement boosts Novell's European effort to make UnixWare the standard Unix on Intel platforms.

Siemens Nixdorf committed to port several middleware applications of its own Unix derivative, Sinix, to UnixWare. In addition to its Intel computers, ICL said it would move UnixWare to its SPARC machines by the end of this year. And UnixWare will be running on Olivetti Intel servers in the same time period.

Novell also announced a partnership with EUnet, one of Europe's biggest Internet suppliers. The companies will offer products that provide Internet access to the users of Novell's network products. Novell's software will be bundled with a number of EUnet's services to provide a one-stop solution for full Internet access.

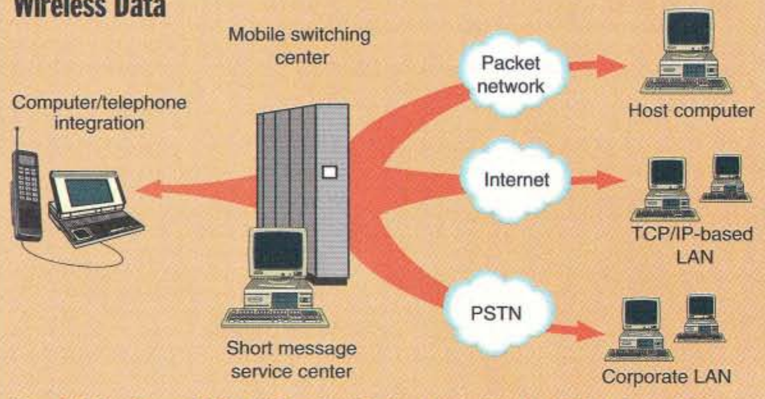
EUnet Traveler will be combined with Novell's LAN Workplace 5. That bundle will provide remote Internet access to individuals on the road anywhere in Europe. Another product, the combination of Inter-EUnet and NetWare MPR 3.0, will let organizations provide corporate Internet access to their remote offices. **— Rainer Mauth**

GSM Meets TAPI

Global System for Mobile communications (GSM) is becoming the de facto global digital cellular standard. GSM also supports data communications and will be integrating computer telephony into its network.

Windows 95 and a new telephony API (TAPI) software development kit will bring the mobile worker new communications applications. TAPI presents a common telephony API to application developers. Nokia worked closely with Intel to add GSM extensions to Intel and Microsoft's TAPI software development kit. With these extensions, third-party developers can access a Nokia cellular phone from a Windows application. Commercial applications should be starting to appear by the time you read this. **—Bob Emmerson**

Wireless Data



A new TAPI development kit for GSM enables telephony applications on cellular phones. In the near future, when the General Packet Radio Service (GPRS) packet network is in place, Internet browsing over GSM will be possible.

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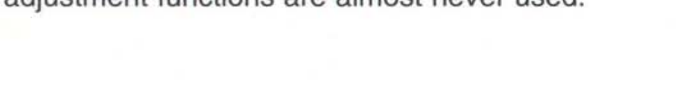
123 CHIP Magazine July 1995



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Circle 520 on Inquiry Card.

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PC Weds TV

Cable TV systems may soon be a pipeline for more than just reruns, sports, and music videos

ADELE HARS

LANCE JACKSON © 1995

As PCs go multimedia and TVs go digital, their worlds are starting to overlap. While few people predict that they'll ever completely merge, cross-fertilization is already taking place. And that could mean good news for PC users and TV viewers alike.

Last year, much of the computer, cable TV (CATV), and telecommunications industries thought interactive TV would be the next big thing to storm living rooms of the world. Millions are currently being spent on high-profile test trials.

In Europe, telcos such as British Telecom, Deutsche Telecom, France Telecom, Belgacom, and Telia (Sweden), and computer companies such as IBM, Digital Equipment, Apple, Olivetti, Silicon Graphics, Hewlett-Packard, Oracle, and, of course, Microsoft, are involved in the tests. The trials essentially strip down a computer and turn it into a set-top box (literally, a box that sits on top of your TV) that is capable of handling interactivity for the TV over the cable network.

But trial after trial is showing that, for a vast majority of people, the TV is something that you flop down in front of at the end of the day with your favorite beverage in one hand and remote control in the other. Channel surfing, yes. More than that? Rarely. (People's attitudes aren't the only issue, though. There are problems of presentation. Text on the TV screen is very low definition, and remote-control devices can severely limit the friendliness of navigation.)

Now, some of the pioneers are turning their attention to PC users. Since they can get all that digital data into our living rooms via the CATV network—or at least they're working on it—why not channel it to the PC? Why not skip the TV altogether?

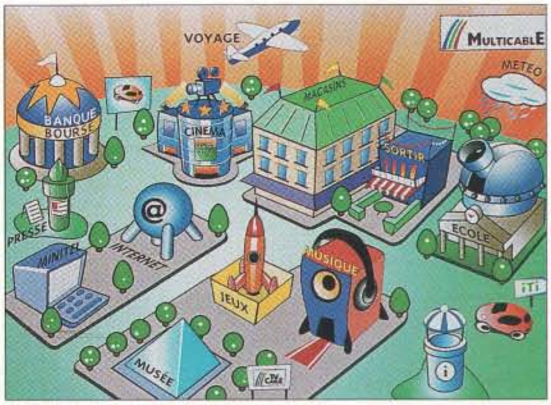
What Must Happen

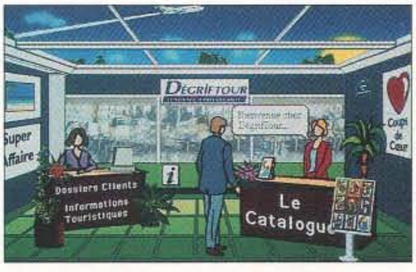
For interactive services over CATV networks to become a reality, changes are needed in two areas: legislation and technology. Europe's cable operators are allowed to offer two-way interactive services only in France, Finland, the Netherlands, Sweden, and the U.K. The European Commission is currently circulating a draft of a directive among the EC member states to liberalize this and related issues in 1996, well prior to the full telecom deregulation that is planned for 1998.

Until then, according to the Yankee Group Europe's report "Cable TV in Europe: Selling More Than Channels," the "same fragmentation and regulatory constraints which inhibit cable telephony will also impede the industry's efforts to deploy advanced interactive and information services."

Two of the most important issues are availability and infrastructure—how many people can get the service and how it's piped into their home. Looked at this way, Europe's CATV markets fall into two groups:

- those places with high penetration of households but limited





Lyonnaise Communications and France Telecom are testing Multicable, delivered to a PC over the CATV network. The home page (left) is a virtual village, where you can click on images of banks, stores, cinemas, museums, travel agencies (above), and so forth to access high-bandwidth consumer services.

ability to support high-bandwidth services without a substantial upgrade to the infrastructure (these tend to be the countries that adopted CATV early on, such as the Netherlands, Benelux, Switzerland, and the Nordic countries);

• those places with low penetration but networks that are more capable of offering interactive services with little additional upgrading (Germany, France, the U.K., and potentially Spain and Italy).

Overall, 40 percent of European homes are "passed," meaning that the physical cable passes by their property line so that the residents could subscribe if they wanted. Eastern Europe is well served by a growing number of new cable networks. However, in some other countries, such as Italy, Greece, and Spain, there is virtually no cable service at all.

Those areas falling into the high-penetration/limited bandwidth category tend to have older, copper-based systems in a tree-branch network topology, which prohibits the possibility of interactivity without substantial upgrades and a virtual network overlay. They would need to upgrade the copper to hybrid fiber coax (HFC). Not a cheap fix. Of course, they don't have the problem of attracting subscribers, as they already have high penetration rates (e.g., 92 percent of all Belgian households subscribe).

The second group of households has relatively new installations using coax or HFC, often in a star topology that can handle interactivity. For them to enter the interactive services market, the big missing ingredient has been low-cost modems specially adapted for the megabits-per-second data speeds that a cable network can offer. These are now starting to hit the market, with products from companies such as Zenith, Intel, Motorola, Sagem, LanCity, and others.

"Cable TV operators now have the opportunity to establish a leading position in the competitive local-loop market of the future," says Paul Knott of Analysis, a consulting firm in Cambridge, U.K. The relatively low cost of converting existing coax cable networks to an HFC architecture will allow them to provide full interactive services economically, he says.

Meanwhile, the traditional telecom operators may be forced to invest in expensive fiber solutions if they are to offer an equivalent service. "Cable TV operators who already have coax and ducts in the ground can upgrade their networks to HFC in stages, limiting the investment needed at each stage," Knott says.

Multicable Turns On in Paris

Cable subscribers in Paris will be the first in Europe to get broadband, interactive PC services over the CATV network, and they may indeed be the first in the world to participate in a trial of the scope planned under the Multicable project.

Multicable provides on-line, broadband commercial services, including full Internet access for PC users at 1.5 Mbps over the CATV network. Because there is so much bandwidth available, the interface is heavily graphical and may even include video clips and sound. The home page features a virtual village, where you can click

More Signs of Convergence

More than 60 companies worldwide, including network operators (such as five major European telcos), systems integrators (including Alcatel and Olivetti), OEMs, and interactive content providers (e.g., Time Warner) are participating in Microsoft's Insight program for interactive television.

- More than 10 companies are currently offering low-cost modems for use over cable TV networks; a year ago there were virtually none.
- Major U.S. players, including Hearst Publishing, Time Warner, and Tele-Communications Inc. (TCI), are planning cable TV network-based Internet access for millions of U.S. subscribers next year.
- An n-tv/Apple/Oracle joint venture aims to bring "information on demand" to business desktop PCs in Germany.
- CableLabs, a consortium of U.S. cable TV operators, has issued an international request for proposals "for hardware, software, and operational support that would allow cable operators to deliver high-speed data services over a hybrid fiber/coax cable network."
- Computer giants such as IBM, Compaq, Digital Equipment, Intel, Bay Networks,and Northern Telecom have joined the CableLabs/IT Convergence Forum.
- Children visiting the "TV at the Crossroads" exhibition sponsored by Philips at the Pompidou Center in Paris assumed that the TVs on display had interactive touchscreens. They didn't. The children became quickly bored.
- Digital is providing the video server for interactive TV trials in Sweden. Apple is providing the set-top boxes for test trials by British Telecom, Telia, and Belgacom. Time Warner's Full Service Network trial in Orlando, Florida, uses a stripped-down SGI Indy as a set-top box.
- The Belgian government plans to allow cable operators to offer on-line information, games, and other interactive services beginning next year. This liberalization is prompted by similar reforms proposed by the European Commission draft directive.
- In Italy, the minister of the post and telecommunications, Agostino Gambino, is pushing for policy changes that would allow CATV operators to offer interactive services starting in 1996. Telecom Italia has indicated interest in offering interactive services over the optical-fiber cable network it plans to deploy to 10 million houses in 1998.

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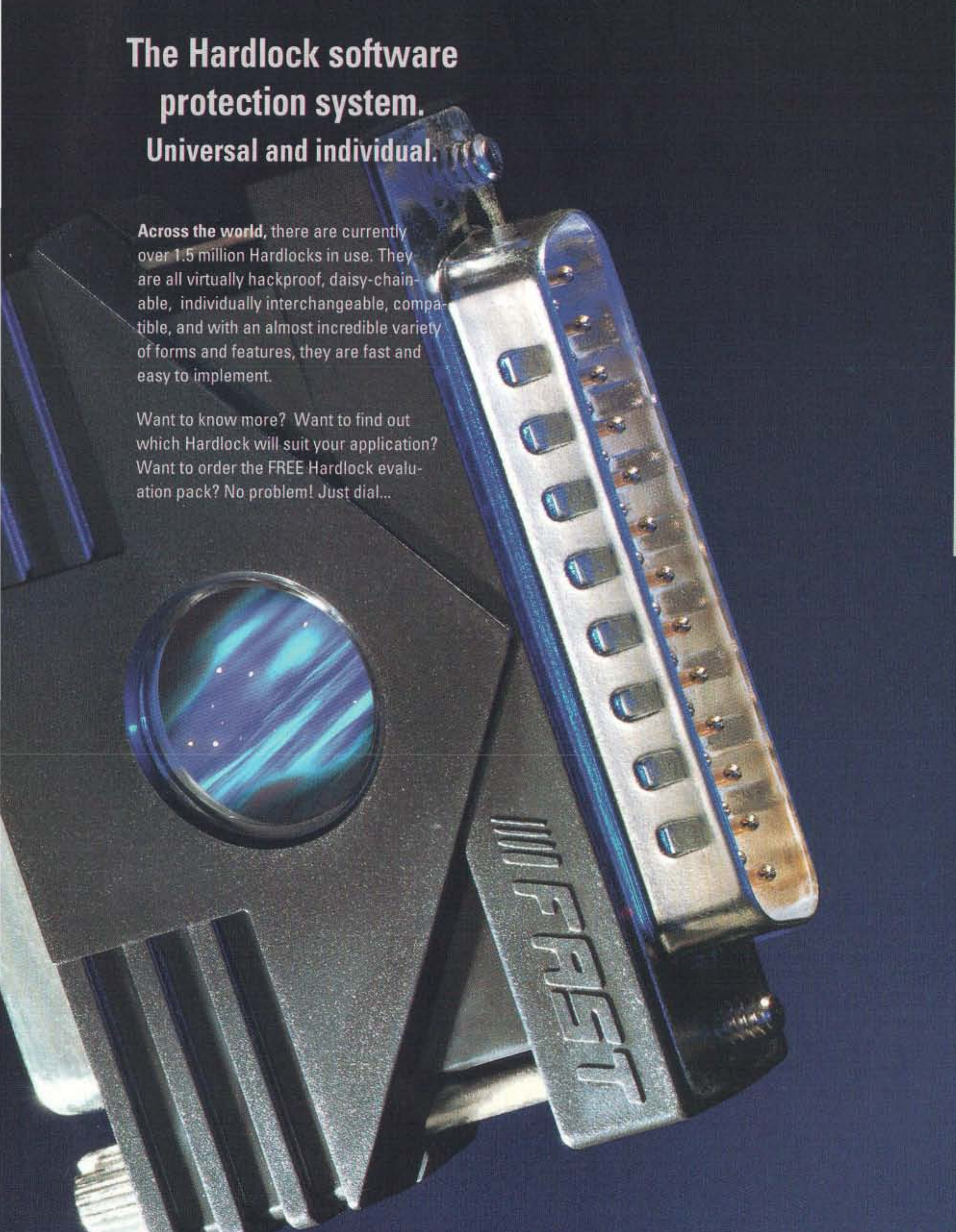

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yes
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and Ready
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on images to access consumer services (see the screen on page 48IS 6). And while one family member is on-line with the PC over the cable network, another can be watching shows on cable channels without any interference.

A major criticism of many interactive TV trials has been that they don't offer compelling new content or services. Multicable hopes to avoid this pitfall by having more than 50 well-known retailers, banks, travel services, museums, restaurant guides, and publishers participate.

Multicable was conceived by the country's largest cable operator, Lyonnaise Communications (LC), with the funding and participation of France Telecom. Pierre Bouriez, LC's development manager, is overseeing the project. In the beginning, he says, the company considered both the PC and the TV with set-top box as possible targets; however, further study revealed that less than 1 percent of TV viewers were willing to do something interactive with their TV.

On the other hand, the percentage of LC's cable subscribers with personal computers had almost doubled in a year to more than 40 percent, half of them with modems. For fully interactive services, the PC was clearly the way to go. Technical and commercial trials are currently under way, available to an initial 10,000 subscribers. LC plans a full rollout to the rest of Paris (more than 180,000 subscribers in all) in early 1996.

The initial monthly pricing for cable subscribers is expected to be 50 francs to 70 francs (US $10-$14) for the basic Multicable service, plus 150 francs (about $30) for unlimited 1.5-Mbps Internet access. LC will offer Web-compatible interface software and a modem rental. The system will use a cable-modem, called the Cable-Port, from Intel.

Web surfers from outside of France might be able to access some of the services, too, and small businesses might eventually be targeted, but those details are yet to be determined.

Learning from Each Other

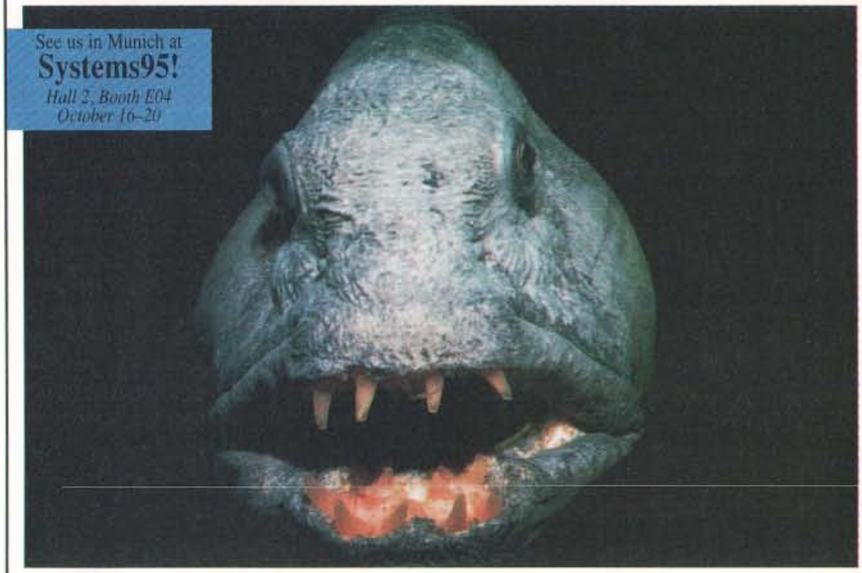
There's a lot that the colliding worlds of the PC and the TV can learn from each other, says Stephen Heppler, director of the Ultralab Research Center at Anglia Polytechnic University in the U.K. He's working with BT, Apple, and the BBC on interface issues for BT's interactive TV trials. (His full report is available at http://www.ultralab.anglia.ac.uk/).

"People expect convergence," Heppler contends. The PC offers more possibilities for collaboration, but so far the TV wins out when it comes to quality narrative and content. Heppler says he'd like to see a "learning layer" incorporated into interactivity so that people can annotate what they see and hear.

Kids have become "information grazers," Heppler says. But he's concerned that, while some trials are indicating that people won't pay for interactivity, today's Nintendo players will expect it when they come of age. Heppler says he hopes investors won't back away. What is needed now, Heppler says, is a "leap of faith."

He's reminded of another time when the naysayers were wrong. In 1937, an editorial in the *New York Times* claimed that TV would never catch on because people just wouldn't have time to sit around and watch it. ■

Adele Hars is a correspondent for BYTE in Paris. She is also a technology writer for the GEID Press Agency, covering everything from semiconductors to telecommunications. You can reach her by E-mail at 100325.3703 @compuserve.com.



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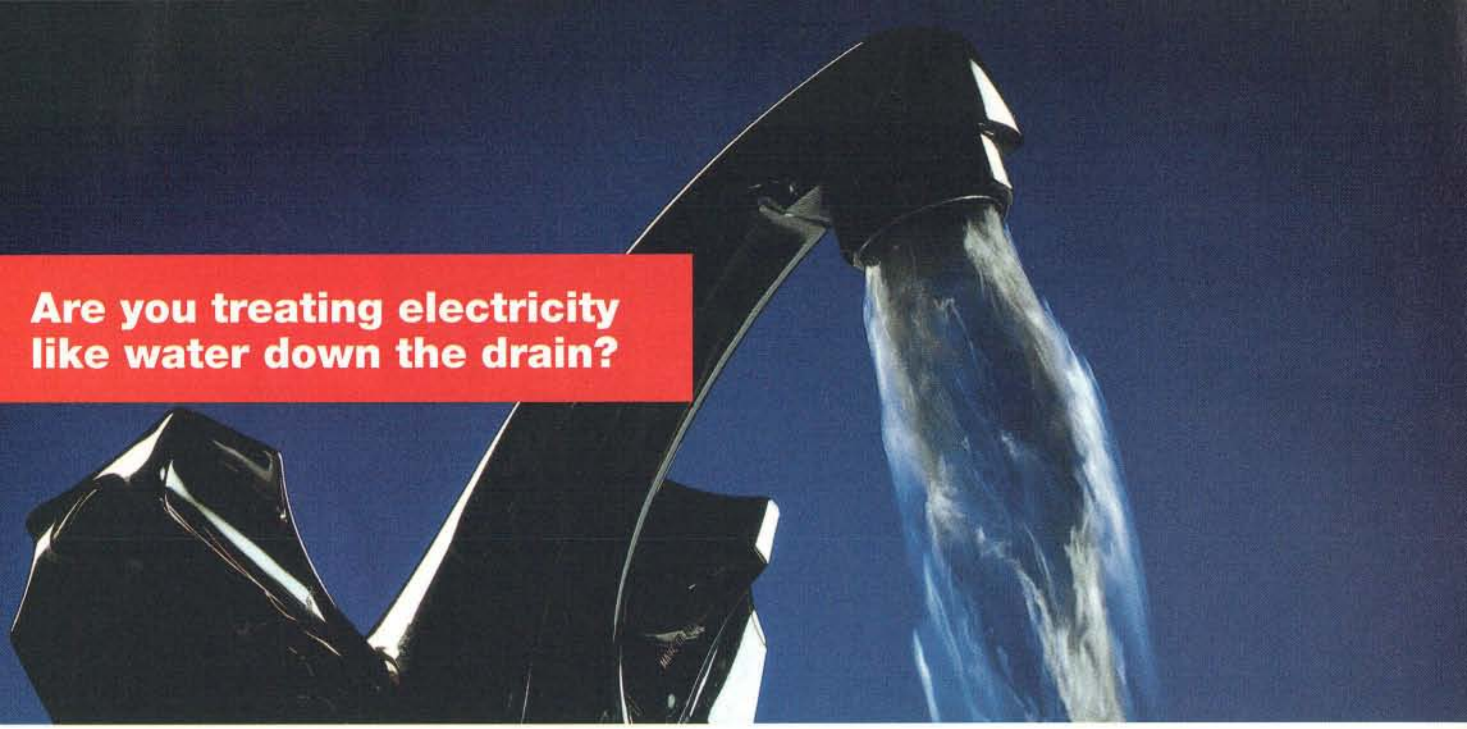

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The ISDN LAN Connection

ELKE GRONERT

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If your company has several branches spread across central Europe, ISDN could be its best internetworking medium. As carriers in Germany, the U.K., France, and Denmark are able to satisfy demand, ISDN is taking off as a versatile intercorporate communications vehicle.

Modern ISDN routers allow for "enterprise links," which couple small and medium LANs to a WAN, and for "branch links," which connect several small LANs to a central site. Last year, about 5 million B-channels had been sold in Europe; more than 2 million were sold in Germany. This year, the market-research firm Dataquest expects a 50 percent increase over last year's numbers.

The rapid growth of B-channels has a strong impact on the LAN internetworking market. Sales of ISDN internetworking units in Europe have tripled from 14,200 in 1993 to 44,400 in 1994. Germany and the U.K. are leading this market with more than 15,000 units sold in each country in 1994.

Three Flavors of ISDN

There are basically three different types of ISDN internetworking products on the market today: stand-alone devices, software multiprotocol routers (MPRs), and standard LAN routers with ISDN capabilities. All router types allow ISDN access from a client LAN PC without additional equipment.

ISDN may soon be your company's internetworking medium of choice

A stand-alone device is a dedicated box that accesses the ISDN network from a LAN. It can support between 2 and 32 Basic Rate Interfaces (BRIs) in one chassis and often provides features like point-to-multipoint connections that are important for larger corporations. A stand-alone device interoperates with any LAN OS. These products link directly to an Ethernet or Token Ring LAN and, therefore, are often easier to install and maintain than combined LAN/ISDN routers. Products in this area come from BinTec, Ouest Standard Telematique, or 3Com Sonix.

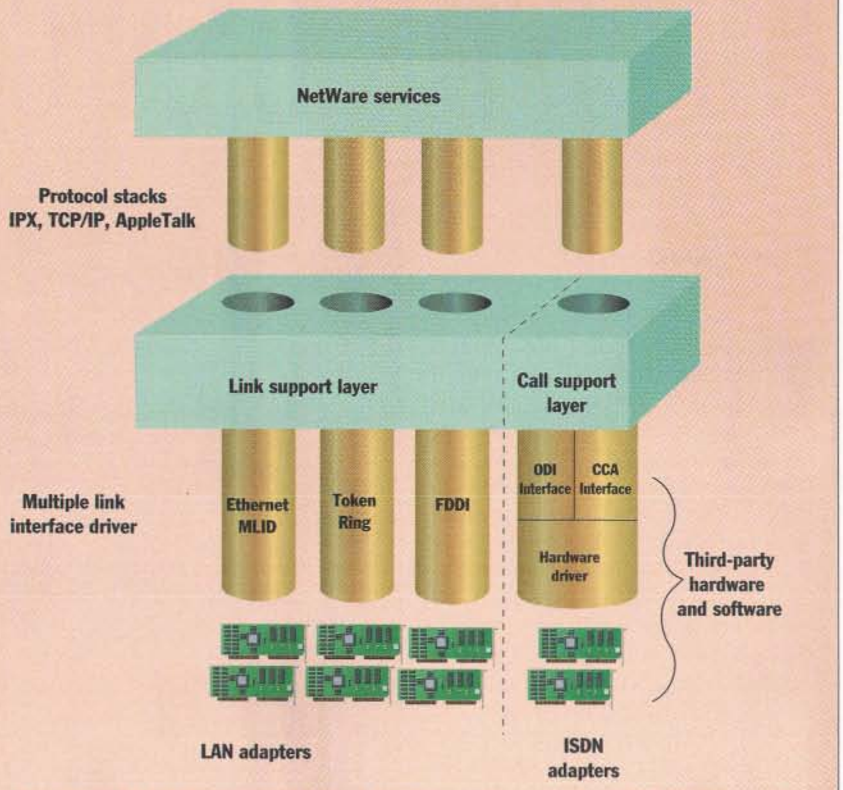
MPRs for ISDN are NetWare loadable modules (NLMs) with a broad range of ISDN functions. Since 1993, such third-party software publishers as AVM, Loewe Iscom, G. Diehl ISDN, Dr. Materna, and Maxpro have developed these products based on Novell's MPR technology (see the figure "How ISDN Plugs In to NetWare" on page 48IS 12). They run on a NetWare server or on a dedicated communications server for ISDN and work on top of an ISDN adapter board with typically one to four BRIs or one Primary Rate Interface (PRI).

Novell's MPRs add WAN capabilities to the NetWare environment. Though it does not directly support ISDN, it offers an interface for third-party developers to access the NetWare protocol stacks. Open Data-Link Interface (ODI), Call Control Agent (CCA), and hardware-specific drivers enable the MPR to treat data from a WAN the way it treats data from a LAN.

The products based on the MPR version 2.0 had some restrictions, including limited support of protocols and spoofing algorithms. But Novell added advanced WAN functions to version 3.0 that enable third-party developers to improve the ISDN internetworking qualities of their products.

Another restraint comes from the fact that a standard ISA/EISA PC Server has space for not more than four plug-in boards. Thus, the hardware limits the number of available BRIs for these

How ISDN Plugs In to NetWare



Novell's MPR adds WAN capabilities to a NetWare environment. Though the MPR does not directly support ISDN, it offers an interface for third-party developers to access the NetWare protocol stacks.

software solutions. To bypass this restriction, the latest MPR versions of AVM and ITK, for example, accept a combination of BRI and PRI boards in one server supporting a total of 60 AVM and 36 ITK B-channels.

Worth noting is that NLMs are usually hardware independent and interoperable, but the NetWare-based ISDN solutions aren't. Each ISDN implementation is expected to operate with only one proprietary ISDN controller. Few of the existing implementations interoperate with other NetWare-based or industry-standard ISDN communications platforms. The result is that users of NetWare-based ISDN implementations do not have the freedom to choose products of different vendors. The same is valid on the remote client side. If you want to be sure that products of different vendors interoperate, you have to buy the same system for the central and remote site or at least check the interoperability of different systems.

A solution for the lack of interoperability between remote and central sites is Point-to-Point Protocol (PPP). Today, PPP is mainly implemented in LAN/ISDN routers from Cisco, Bay Networks, or 3Com. PPP actually comprises a suite of protocols providing encapsulation, data-link control, data-link inverse multiplexing, link-quality monitoring, access authentication, data compression, network-layer configuration, and multiplexing. A key design goal for PPP was interoperability between systems of different performances and capabilities. PPP fixes minimal services to be provided by a router and defines optional services that can be negotiated between two routers. Each time a PPP connection is established, the two linked peers dynamically check a set of operational parameters supported by both sides.

Unfortunately, Novell's NetWare PPP depends on the ISDN boards' hardware drivers. Because there is no agreement among the ISDN board vendors regarding the hardware support for the PPP protocol suite, PPP services of MPR solutions are often reduced, and interoperabilty is not warranted.

The Multilink PPP Protocol plays a decisive role for channel bundling and aggregation of ISDN bandwidth, which is most important for large file transfers,

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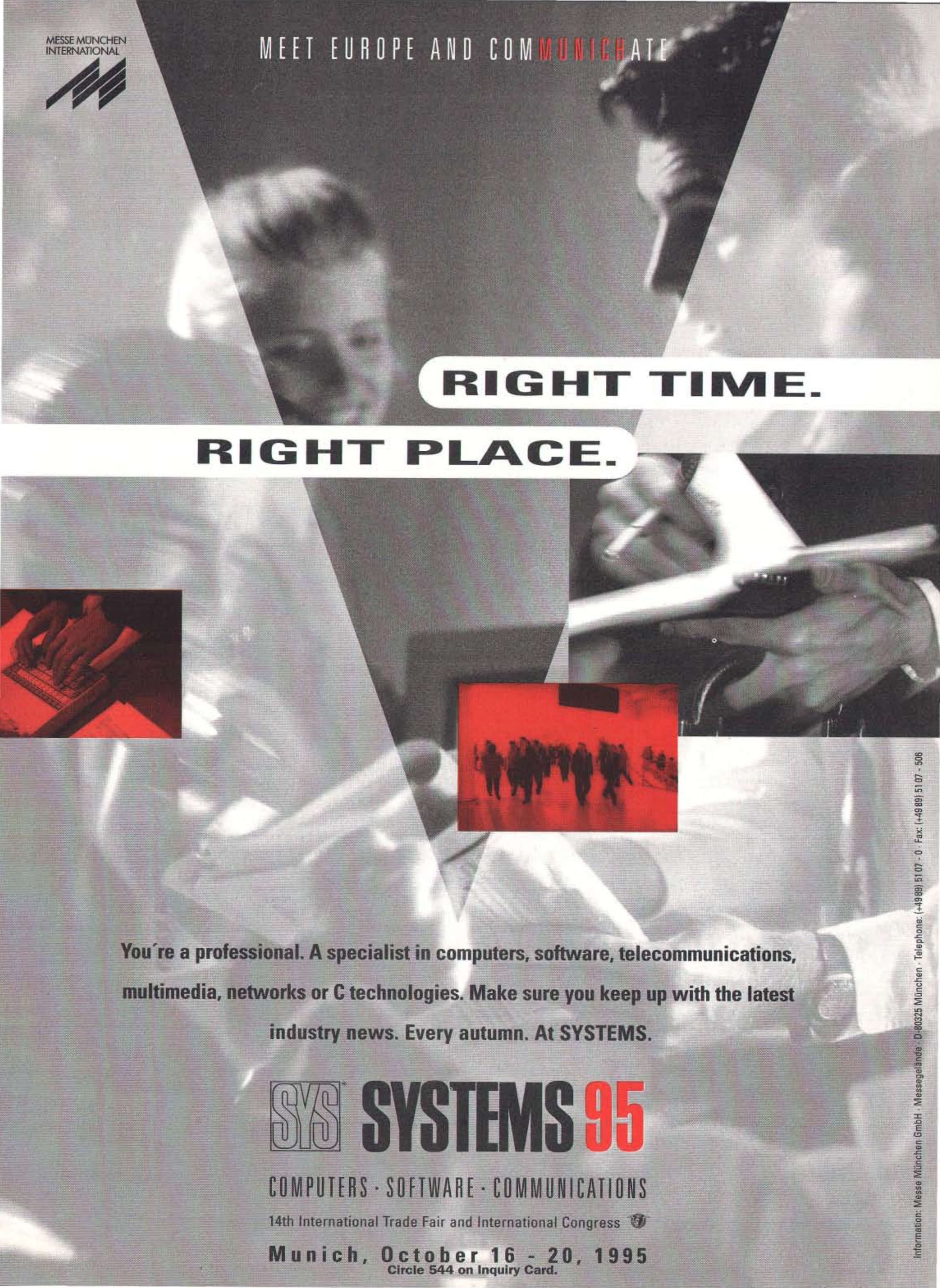

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Important ISDN Router Features

- **Routed LAN protocols:** Most products support IP and IPX. Multiprotocol router (MPR)–based solutions usually offer a broader range of routed protocols such as SPX, NLSP for IPX, and OSPF for TCP/IP. They can also bridge the "nonroutable" protocols NetBIOS and SNA.

- **Number of supported BRIs:** Products that support one or two interfaces are appropriate for branch offices and small- and home-office users. If you expect your data traffic to increase during the life cycle of the product, you'd better look for products that support multiple Basic Rate Interfaces (BRIs) or Primary Rate Interfaces (PRIs).

- **Dynamic or static aggregation:** Static aggregation lets you define a number of aggregated B-channels for a certain link. Dynamic aggregation automatically adds new channels to ensure fast data transfer, but it also reduces bandwidth in case of low traffic, saving costs.

- **Support of Multilink PPP:** Multilink Point-to-Point Protocol (PPP) defines how to bundle bandwidth in a heterogeneous environment. Products that support this protocol make you more independent of the vendor. You're not tied to a single product type, so you can use different vendors' products at the central and remote sites.

- **Spoofing:** As LAN protocols are not developed for use in the WAN area, spoofing suppresses the LAN protocols' polling and reduces costs.

- **Short-hold mode:** Short-hold mode disconnects lines with no traffic but keeps the protocol information to quickly activate the link when new data is transmitted, saving costs.

- **Watchdog functions:** The router can calculate cost-efficient data transfer according to local tariffs.

especially when the 64 Kbps offered by a single B-channel is not enough. In this case, the router has to detect vast amounts of data to be sent and dynamically add more bandwidth. Multilink PPP will make this process transparent to different vendors' devices. Only a few vendors are currently supporting this protocol.

Aggregation can be dynamic, often referred to as "on demand," or static, where special applications and connections have a predefined bandwidth and the aggregated call is set up automatically. Static aggregation implies that the user has to pay for every aggregated B-channel, whether it is used or not.

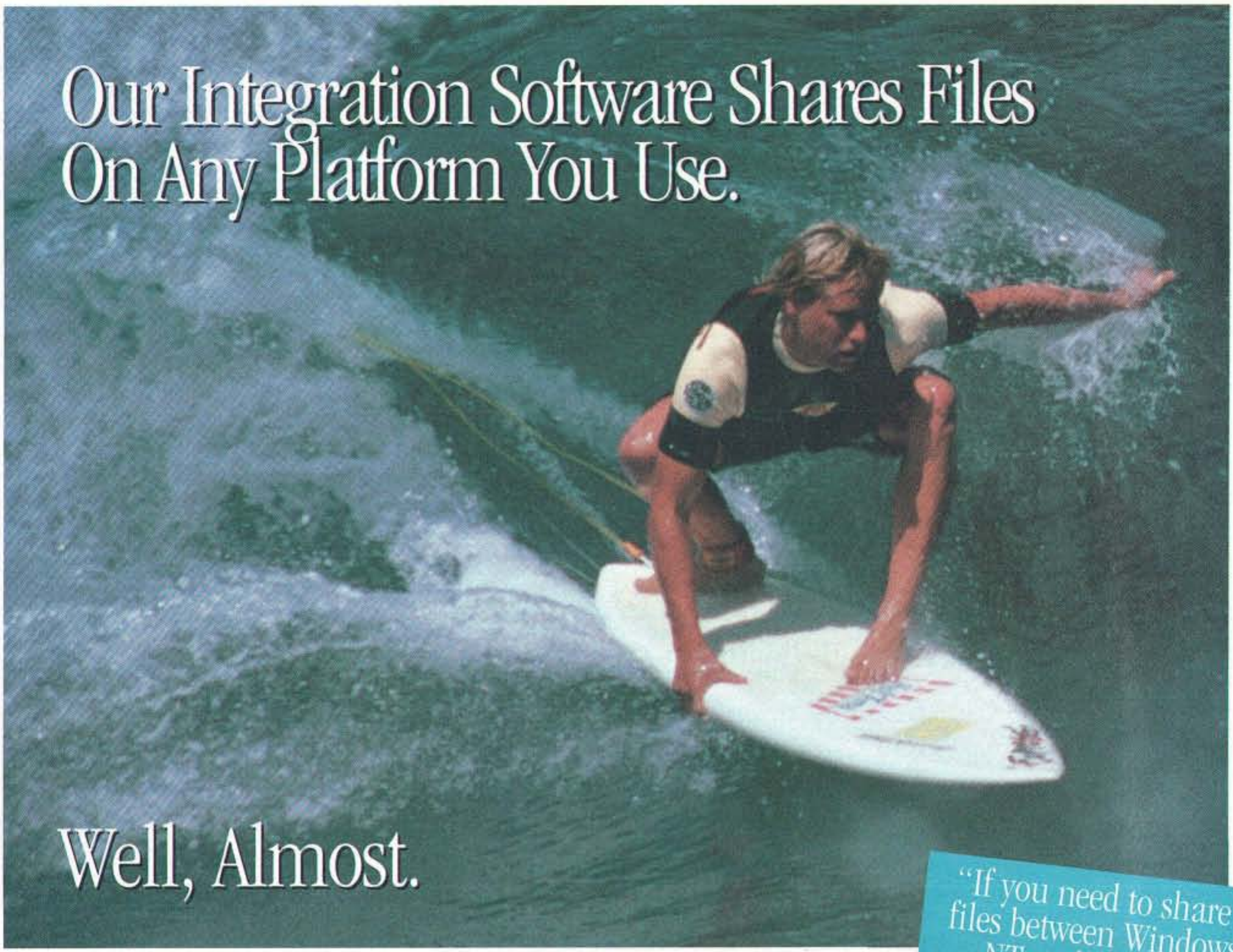
Most of today's products are not able to bundle more than two B-channels. This limitation is due to the fact that most boards can't aggregate over multiple boards. Novell's MPR 3.0 lets you aggregate two ISDN channels in the Branch Link version and up to 16 in the Enterprise Link version.

If a central-site LAN needs to connect to only a small number of branch LANs, a point-to-point connection is all that is required. In this case, each B-channel can link to only one dedicated destination. Thus, the number of destinations is limited by the number of B-channels available. But some routers also offer point-to-multipoint connections. A point-to-multipoint–capable router can store hundreds of destination numbers in its routing table and call up each destination on any free channel. This feature is useful for big companies, which need to link to a lot of branch offices but can't afford a dedicated channel for each location.

Cutting Costs

Routers were originally designed to segment a LAN environment. To check the status of the connected devices, the router polls every 30 to 50 seconds (depending on the protocol). This technique makes sense for monitoring a LAN, but when it comes to linking remote sites over ISDN, each poll means additional connection costs to the user. To avoid these costs, ISDN routers use a technique called *spoofing*. The ISDN router then sends a message to a LAN router to pretend that the remote site is still active without actually setting up a call. Today, spoofing for SPX is a rare feature, whereas many products provide IPX spoofing.

Another function that saves communications costs is the short-hold mode. When one of the two communications devices detects no traffic for a certain time, say for 20 seconds, it disconnects the link but keeps the protocol information. As soon as new data arrives, it activates the link with the same protocol setup. This procedure saves costs not only because of the line interrupt but also because it does not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need to negotiate the protocol, which usually takes several seconds.

Many ISDN routers—software and stand-alone—feature watchdog functions. However, the actual implementations in the products are very different. Watchdog functions are sophisticated techniques to reduce connection costs.

Routers that include a more advanced watchdog function know the price and the duration of a basic connection unit. These devices are able to decide if it is cheaper to turn the line down or to hold it. For example, a data transmission might take 30 seconds, but if you have to pay for the time in 60-second increments, it is better to keep the line and wait for a possible second transmission within the remaining 30 seconds. If there is no data transmission during this period, the line will be disconnected, and the router will wait for another call to connect again.

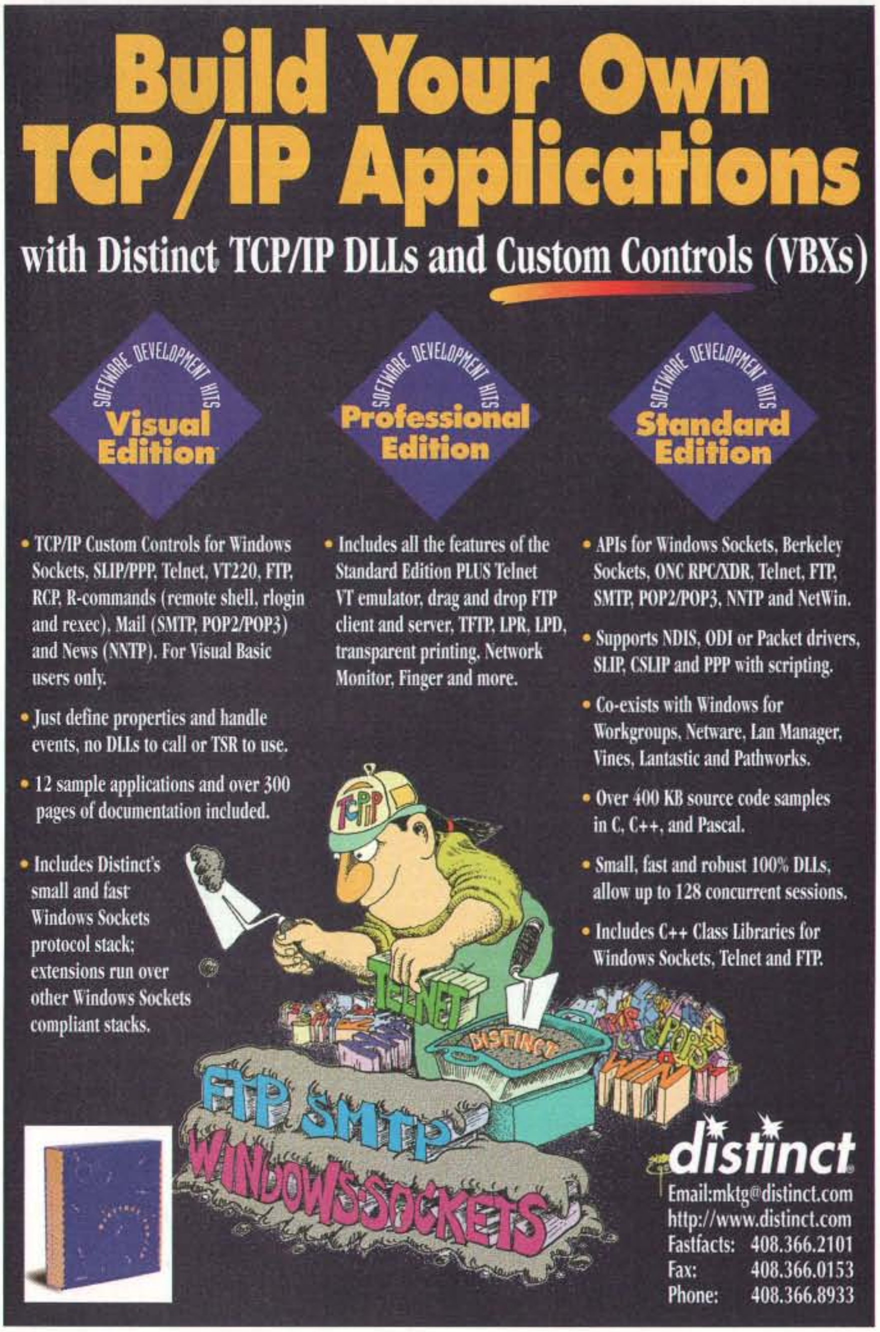
A third category of watchdog functions includes application-specific knowledge. For example, if an application sends data every 3 minutes, the router is able to learn how to handle this kind of traffic as effectively as possible, considering connection costs and time units.

However, finding the lowest rates is not easy to implement. The variety of ISDN tariffs in different European countries makes it tough for a vendor to keep up with rate changes.

There are other important features such as automatic callback, filters to avoid redundant traffic, and management functions that offer monitoring and accounting information.

Most products in the ISDN internetworking area support NetWare. But if you plan to equip your LAN with Windows NT, look at products that come from companies such as Acotec, Brand Communications, NCPengineering, and Synaptel. ■

Elke Gronert is a freelance writer based in Munich. She specializes in telecommunications and networking. You can reach her on the Internet or BIX at editors@bix.com.



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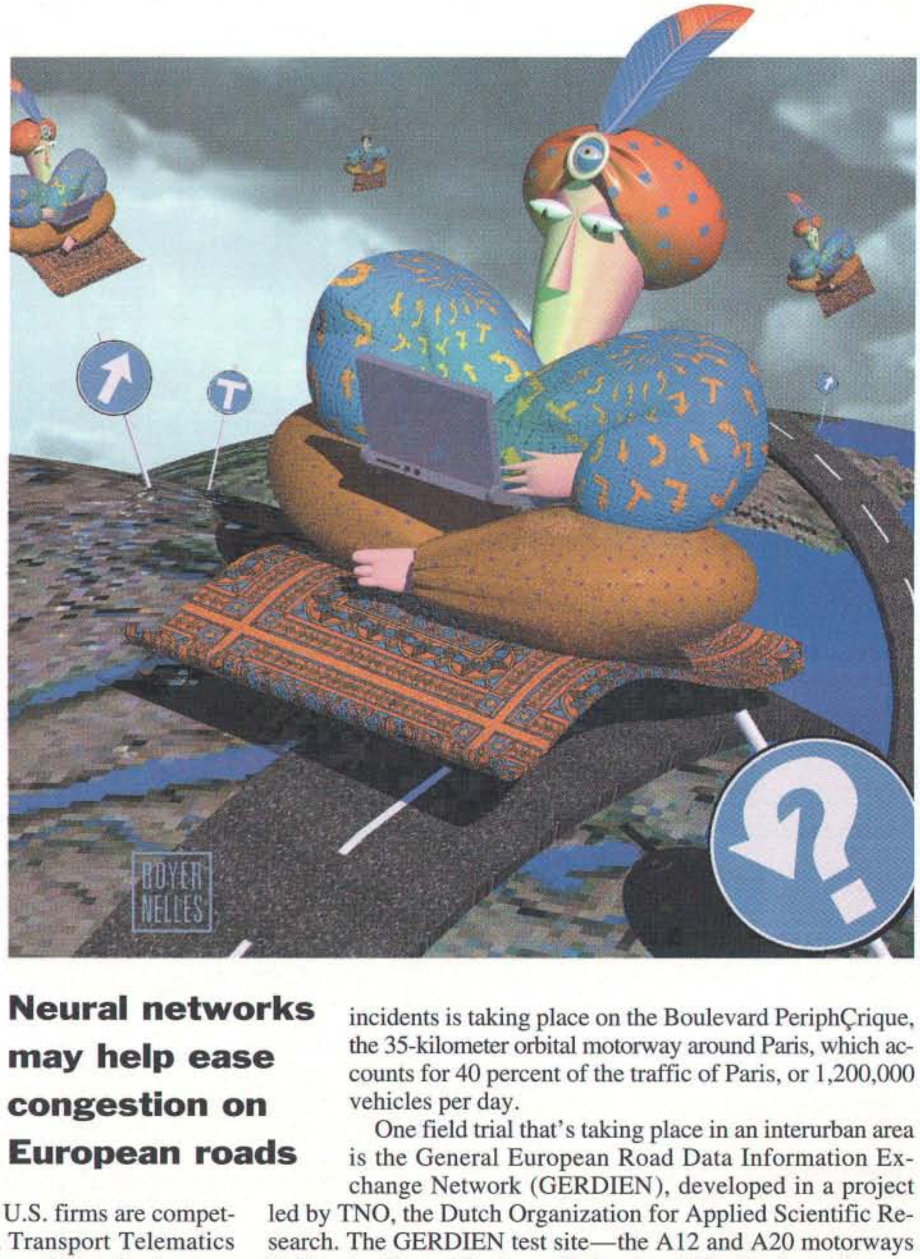

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Stop-and-go traffic is fast becoming the norm on many of Europe's major highways. And the problem is getting worse, not better.

In Europe, some 120 million cars compete for a clear stretch of road each day. That number will increase to 140 million by the year 2000. New roads are expensive and cause environmental damage. Several European organizations are engaged in projects studying how to reduce traffic congestion using sophisticated traffic forecasting and management programs.

Telematics

"The key to smart mobility is intelligent traffic telematics," says Patrick Grillo, project officer of the European Commission's (EC's) Dedicated Road Infrastructure for Vehicle safety in Europe (DRIVE) II transport telematics project. The EC has marshaled the forces of telematics, a blend of information technology (IT) and telecommunications, to relieve Europe's congested road networks and increase the efficiency and safety of road transport.

The DRIVE program was initiated in 1988 by the EC. It consists of some research projects testing computer-assisted systems for route guidance, travel information, fleet management, and traffic forecasting and monitoring.

Neural networks may help ease congestion on European roads

The Europeans are not alone in their telematics efforts. Several Japanese and U.S. firms are competing to be the first to supply Advanced Transport Telematics (ATT) applications. In Japan, 200,000 cars with navigation systems have already been sold. In America, a major R&D program has been launched with strong financial backing from the U.S. Congress.

ATT applications address such questions as: How can we use existing roads more efficiently? How can vehicles be guided to bypass accidents and other incidents that cause gridlock?

Monitoring Traffic

Several traffic-monitoring experiments are happening in major European cities. In France, automatic detection of traffic-stalling incidents is taking place on the Boulevard PeriphÇrique, the 35-kilometer orbital motorway around Paris, which accounts for 40 percent of the traffic of Paris, or 1,200,000 vehicles per day.

One field trial that's taking place in an interurban area is the General European Road Data Information Exchange Network (GERDIEN), developed in a project led by TNO, the Dutch Organization for Applied Scientific Research. The GERDIEN test site—the A12 and A20 motorways linking the Hague, Hoek van Holland, and Utrecht in the Netherlands—is one of the most populated parts of Europe. Traffic on the motorways in the project area covers 60,000 movements per day in each direction.

The Rhine/Main Area Project for Integrated Traffic management (RHAPIT) is an initiative of the German federal state of Hessen and part of an existing integrated traffic-control system in the Rhine/Main area. The core of RHAPIT is a knowledge-based traffic-information system called System of Cellular Radio for Traffic Efficiency and Safety (SOCRATES). SOCRATES uses bidirectional mobile radio communication over GSM/D1 for route guidance, driver information, and emergency calls (see the figure "A Neural Network Studies Traffic Patterns").

The goal of these projects is to implement an on-line system for monitoring traffic and forecasting the traffic density during the next 30 minutes. An on-line forecasting system should enable a traffic operator to recognize changing traffic situations early and to modify traffic lights and message signs. It also should be capable of estimating travel times on a congested road and displaying congested roads as colored sections on the operator's screen.

Using Neural Networks

Because traffic flows are erratic, it's not easy to predict how clear or cluttered roads will be at any given time. Minor incidents (e.g., a flat tire) can tie up a motorway for several kilometers. Traffic is a complex process with several interdependent parameters. The only way to accurately forecast whether traffic will be heavy or light is to use the raw data detected by loop detectors. Neural networks are used to process and analyze the data.

Neural networks can derive estimations, predictions, and forecasts out of a given set of time series. As opposed to statistical approaches to forecasting, neural networks don't require an underlying prediction model.

The GERDIEN project deployed a back-propagation neural network that runs in an embedded environment with other traffic management applications. To construct the neural network, project members used the network-simulation package NeuralWorks Professional II Plus from NeuralWare (which is distributed in Europe by Scientific Computers, +44 1293 403636). NeuralWorks is capable of generating C++ code to integrate the network into any given environment.

The back-propagation model belongs to the group of supervised-learning, feedforward networks, which adjust the internal network nodes from the known output information. Because the dynamic traffic-forecasting system of GERDIEN required on-line predictions, the feed-forward feature of back-propagation networks was necessary for this project.

A neural network consists of many nodes joined together by connections so that the outputs of the nodes are inputs to others. The nodes are the basic building blocks of the neural network. A node takes in a set of inputs and computes the output according to a transfer function.

The output state of a single node is characterized as either on or off. A change

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from one state to the other is triggered when the sum of the inputs (weighted by the strength of their respective connections) passes a threshold, represented by the transfer function. To ease the problems of analysis and visualization, it is common practice to arrange the nodes in layers, with all nodes in adjacent layers connected to each other.

The "training" of the network is an iterative process based on large numbers of data samples representing the traffic flow within a certain region. Using standard connection weights, the network computes a set of outputs that is moved from the input layer to the hidden layer. The system compares this set of outputs with the input values by calculating a root mean square difference (or global error) and modifies the connection weights to displace the outputs toward the expected values. If the training is successful, the global error is reduced.

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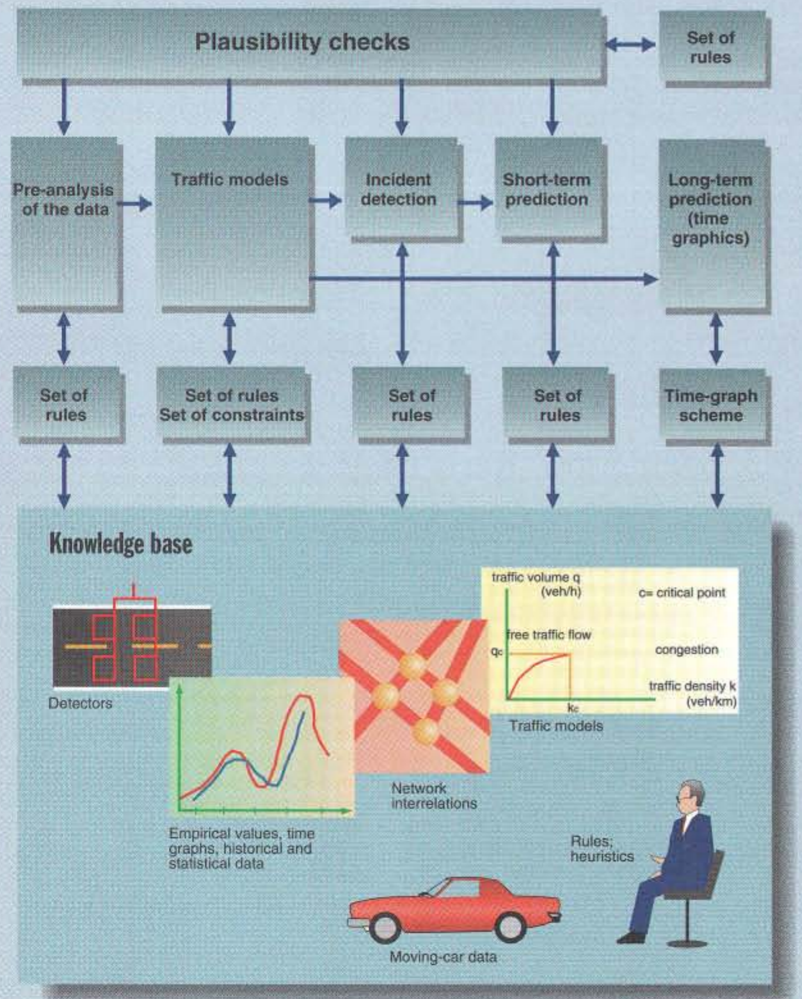

A Neural Network Studies Traffic Patterns

Neural networks help classify traffic situations by mapping the detected traffic data to a set of defined traffic situations. However, they can predict only traffic flows they are used to.

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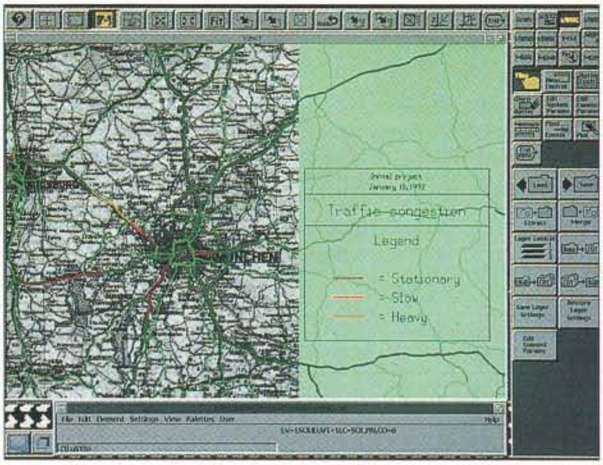

A traffic management system monitors the current status and dynamically forecasts the traffic density during the next 30 minutes. It helps traffic operators recognize changing traffic situations early. They can then modify traffic lights and message signs accordingly. The system estimates travel times and displays congested roads as colored sections on the operator's screen.

In the GERDIEN project, a separate back-propagation neural network was constructed for each prediction point (i.e., loop detector). Because forecasts of speed, flow, and occupancy were needed, and 5-, 15-, and 30-minute forecasting intervals were used, a single prediction point could have up to nine forecasting points (and associated neural networks).

The Good and the Bad

The GERDIEN project proved that neural networks can produce reasonable forecasts of traffic volume and occupancy. However, it also showed where they did not work.

"The forecast a neural network achieves is only as good as the data you used to train it," says Mark Dougherty a neural-network expert from the University of Leeds, who has been involved in the GERDIEN project. "As soon as unusual incidents that have not been trained occur, the net fails."

The GERDIEN project used a single network that had to cope with all traffic situations. Other approaches work with specific networks for different traffic situations. In this case, one needs a hierarchy of networks, including one that decides which one is applicable. According to Dougherty, the training of a system with several networks can get very fastidious, and the choice of "abnormal" situations is then likely to be dependent on the person who trained the network. ■

Paul van de Braak is a freelance writer who is based in the Netherlands. You can contact him on the Internet or BIX at editors @bix.com.

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102, bd de Valmy
92700 Colombes
France
+33 46 499347
fax: +33 46 499343

GREDIEN
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+31 15 696770
fax: +31 15 697782

RHAPIT
Heusch/Boesefeldt
Liebigstr. 20
52070 Aachen
Germany
+49 241 168050
fax: +49 241 16805 55

SOCRATES
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SMARTKEY PLUS is the professional protection system against illicit duplication of software.

The intelligent hardware key is plugged into the PC's parallel port: protected programs cannot be run without it.

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Circle 510 on Inquiry Card.

WHAT'S NEW Hardware

MONITOR ANALYZES YOUR WANS ▲

The Logix Monitor, Logix Communications' new PC-based WAN protocol analyzer, provides a concise view of your data in real-time and in background mode. It spools data in ASCII files for off-line analysis and lets you replay the data at various speeds. Triggers, timers, and counters are programmable and offer string searching, event trapping, exception alarms, data highlighting, and interactive simulation. An included alarm/modem interface activates a pager or beeper to keep you informed of network anomalies when you are away. Protocol decodes include X.25, frame relay, X.224, TCP/IP, and PPP.

Price: £1500.
Contact: Logix Communications
Wittshire, U.K.
+44 1380 722192
fax: +44 1380 727043.
Circle 1314 on Inquiry Card.

NEW PLUG-IN DATA ACQUISITION BOARDS

The DaqBoard/200A and 216 data acquisition boards provide 10-microseconds-per-channel scanning over their 16 on-board analog input channels and maintain the same performance over their 256 potential expansion channels. The boards digitize signals via a 16-bit, 100-kHz A/D converter, capable of real-time storage to disk. They provide three levels of software support: DOS and Windows programming language drivers and Visual Basic custom controls (VBXes), Windows-based setup and acquisition applications, and drivers for third-party software packages such as Snap Master, Labtech Notebook, DASYlab, and LabVIEW.

Price: £886.
Contact: Scensys
Arlesbury, U.K.
+44 1296 397676
fax: +44 1296 397878.
Circle 1318 on Inquiry Card.

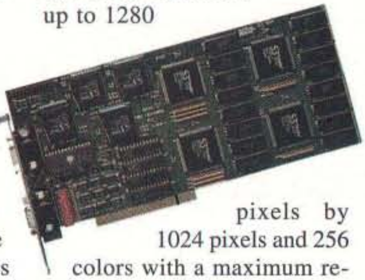
CABLE ANALYZER HELPS PREPARE FOR ATM ▼

The WireScope 155 is a category 5, level II cable tester that verifies that your UTP will operate with 155-MHz ATM equipment. According to the vendor, the analyzer supports ATM Forum requirements and TIA 568A specifications. It also guarantees compliance with the new T568A specification for category 5 cable testing and reports the margin by which the cable passed or failed. WireScope comes with a rugged rubber casing and field-changeable battery packs that give 5 hours of continual use.

Price: £3895.
Contact: MASE
Crydon, U.K.
+44 181 665 7577
fax: +44 181 6836440.
Circle 1315 on Inquiry Card.

PCI GRAPHICS ADAPTER FOR FOUR MONITORS ▼

If you're running multiple applications and need to increase your screen real estate, check out the Quad Lightning PCI graphic accelerator, which uses four independently programmable S3 Vision 868 chips. Included virtual screen software allows multiple screens to become one large desktop, configured horizontally or vertically. You can spread applications across several monitors or drag them from one screen to the next. Each monitor can run at resolutions up to 1280 pixels by 1024 pixels and 256 colors with a maximum refresh rate of 75 Hz. Drivers are supplied for Windows 3.x, Windows NT, OS/2, and Microstation. A two-port version of the Quad Lightning is available for PCI- and VL-bus architecture.



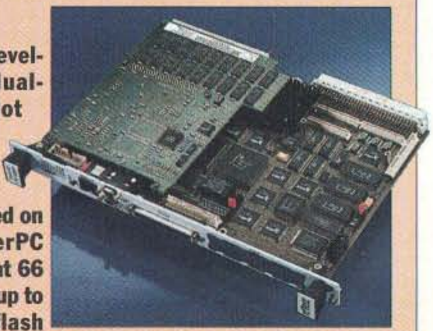
Call for price.
Contact: Colorgraphic Communications
Dorset, U.K.
+44 1202 669244
fax: +44 1202 67221.
Circle 1316 on Inquiry Card.

GPS RECEIVER ON A PC CARD

Opti International's Global Positioning System (GPS) receiver on a Type II PC Card (formerly PCMCIA)lets users of notebooks, organizers, and PDAs obtain such exact location information as position, direction, altitude, and speed. The SatNav Card interprets signals received from the GPS network of satellites by emulating a serial communications port.

Call for price.
Contact: Opti International
Barking, U.K.
+44 181 507 1818
fax: +44 181 594 2236.
Circle 1313 on Inquiry Card.

POWERPC BOARDS FOR REAL-TIME APPLICATIONS



Force Computers developed its IBC-60x dual-PMC and single-slot VME boards for embedded real-time applications. The IBC-60x boards, based on the 603/604 PowerPC processors running at 66 or 100 MHz, provide up to 8 MB of on-board flash memory, two serial RS-232 I/O ports, and an Ethernet 10Base-T connector. They feature an optimized interrupt controller and an integrated linked-list DMA controller and support the real-time OSes VxWorks, pSOS+, and Lynox.

A single-slot version, the CPU-60xRT is also available. Both versions use PCI as a central on-board bus for data transfer rates up to 128 MB.

Call for prices.
Contact: Force Computers, Munich, Germany
+49 89 60814 0; fax: +49 89 60814 276.
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For Borland C/C++, Microsoft C/C++, Borland Pascal

RTKernel
Real-Time Multitasking for DOS

RTKernel is a professional, high-performance, real-time multitasking system for **MS-DOS** and **Embedded Systems**. It can use DOS device drivers and BIOS, and runs other DOS applications as a task - even **Windows!**

RTKernel is **loaded with features**: an unlimited number of tasks, excellent performance, a full set of inter-task communication functions (semaphores, mailboxes, synchronous message-passing), real and protected mode support, drivers for up to 38 COM ports and Novell's IPX services, and lots more...

It's **ROMable** and **very compact** (about 16K code, 6K data), making it ideally suited for Embedded Systems.

RTKernel is well-documented and easy to use. All hardware drivers always come with source code; kernel **source code available** at extra charge. **No run-time royalties.**

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- data acquisition
- real-time simulations
- background processing

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France	Technology Rescue	1 30660136
Italy	Silicon Valley	(049) 871-3444
Malaysia	Pentatronics Technology	(04) 642-2595
Russia	ProSoft	(095) 971-2059
Sweden	Databiten	(026) 256493
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USA	On Time Marketing	(516) 689-6654

Libraries: DM 795
Source Code: add DM 695

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NEW MULTIFUNCTIONAL STORAGE DEVICE

Cristie's new multifunctional storage device is a combination of a phase-change optical drive and a CD-ROM drive. Photon is housed in a rugged metal box complete with a carrying handle. It has SCSI and parallel printer ports that allow for quick and simple connection to your PC or laptop. Photon can be used for software installation, backup, or data interchange.

Price: £999.

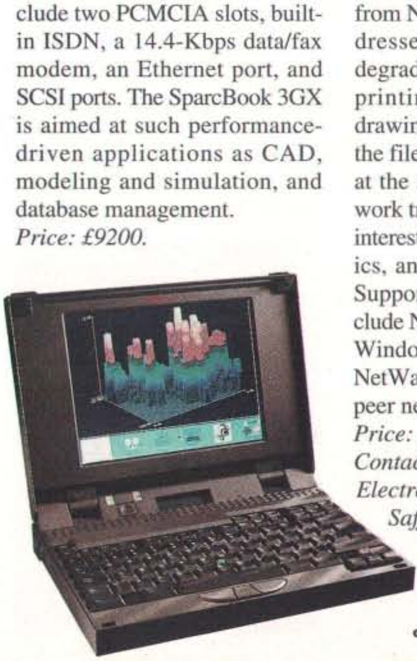
Contact: Cristie Electronics, Stonehouse, U.K.
+44 1453 823611; fax: +44 1453 825768.

Circle 1320 on Inquiry Card.

SPARCBOOK DELIVERS MOBILE PERFORMANCE ▼

Tadpole's new notebook format SparcBook 3GX is equipped with a 110-MHz MicroSparc II processor, a high-resolution 800-by 600-pixel, 10.4-inch active matrix TFT display, and a 1.2-GB SCSI disk. Other features include two PCMCIA slots, built-in ISDN, a 14.4-Kbps data/fax modem, an Ethernet port, and SCSI ports. The SparcBook 3GX is aimed at such performance-driven applications as CAD, modeling and simulation, and database management.

Price: £9200.



Contact: Tadpole Technology
Cambridge, U.K.
+44 1223 428200
fax: +44 1223 428201.

Circle 1321 on Inquiry Card.

SERVER ACCELERATES GRAPHICS PRINTING

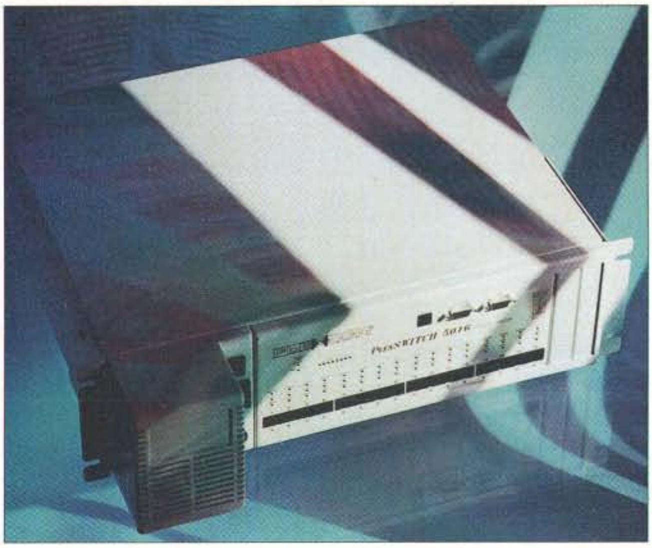
The PRS 750 print room server from Nighthawk Electronics addresses the problem of speed degradation on networks when printing large documents or drawings. It transfers data from the file server to the print server at the same speed as other network transactions, which should interest those in the CAD, graphics, and publishing businesses. Supported networking OSes include NetWare, Unix, Vines, and Windows NT, plus the Personal NetWare and LANtastic peer-to-peer networks.

Price: starts at £900.

Contact: Nighthawk Electronics
Saffron Walden, U.K.
+44 1799 540881
fax: +44 1799 541713.

Circle 1322 on Inquiry Card.

Circle 560 on Inquiry Card (RESELLERS: 561).



NEW 16-PORT ETHERNET SWITCH ▲

ML Electro-Optics' new 16-port Ethernet switch, the PlexSwitch 5016, helps maximize Ethernet bandwidth. It does so by creating high-performance workgroups within congested LANs. Since it offers an internal switching capacity of 100 Mbps, all ports can intercommunicate at 10 Mbps simultaneously. Two external high-speed ports provide 100-Mbps access to high-performance file servers via FDDI or Fast Ethernet.

The PlexSwitch is based on a "store and forward" architecture and processes multiple packets in parallel. It is appropriate for users who have several standalone bridges in their network or who are considering an alternative to FDDI to obtain higher bandwidth.

Call for price.
Contact: ML Electro-Optics
Oldham, U.K.
+44 161 627 1100
fax: +44 161 678 0124.
Circle 1319 on Inquiry Card.

TAPE STATION CONNECTS DIRECTLY TO ETHERNET

Tape Station is a new series of tape drives that connect directly to any Ethernet LAN via either BNC or UTP connector. Each Station has a unique name so that several units can be installed. The devices offer capacities from 525 MB to 8 GB using data cartridges or DAT drives. All units ship with Windows and DOS software and include the ability to back up Novell file servers. Software for OS/2 and other OSes, including a Windows 95 version, are under development.

Price: starts at £1299.
Contact: Cristie Electronics
Stonehouse, U.K.
+44 1453 823611
fax: +44 1453 825768.
Circle 1340 on Inquiry Card.

FAST ETHERNET ADAPTER FOR PCI SYSTEMS

SysKonnect's Fast Ethernet adapter, SK-NET Flash 10/100, supports the 100Base-TX and the 10Base-T standards, so a protocol exchange from 10 to 100 Mbps is not necessary. The PCI bus–based system offers full plug-and-play slots, so that the PC automatically recognizes and configures the card after you've mounted it. The 32-bit bus offers internal data rates of 132 MBps. The card supports full-duplex operation and can increase the network bandwidth to 200 Mbps. The SK-NET 10/100 comes with drivers for NetWare, Windows, Windows NT, IBM LAN Server, and Unix.

Price: £529.
Contact: SysKonnect
Schneider&Koch
Ettlingen, Germany
+ 49 7243 502 0
fax: +49 7243 502 989.
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Circle 527 on Inquiry Card.

DRIVE EIGHT MONITORS WITH A MAC ▼

The new VOPEX-8M video splitter lets a single Mac drive up to eight video monitors, all displaying the same image. With a 100-MHz bandwidth, this device displays images that are as crisp as the originals. All monitors connected to the VOPEX must be the same type. The unit connects directly to the Mac's video-out port via an included 3-foot interface cable. Because all eight outputs are individually buffered, the monitors don't affect one another.

Price: £692.

Contact: Instrumentation Test & Measurement
Wimborne Dorset, U.K.
+44 1202 872771
fax: +44 1202 871052.
Circle 1312 on Inquiry Card.

INTELLIGENT ENERGY SAVER

The IES (for Intelligent Energy Saver) remote controller with built-in modem can automatically turn PC systems, monitors, printers, and fax machines on and off. For example, the IES's scheduling function lets you turn the system on only during standard working hours. You can also automate the system to allow backups, E-mail, or long-distance fax messaging to take place at off-peak times, when charges are lower. If control on demand is required, you can operate the IES via the internal modem link, which lets you receive faxes without leaving the system on continuously. Additional energy-saving features include automatic printer or monitor shut down and automatic power off when the IES detects an unstable power source.

Price: £145.

Contact: Network Connectors
Bristol, U.K.
+44 1275 848421
fax: +44 1275 848421.
Circle 1342 on Inquiry Card.

TWIN MONITOR MAPPER

TWIN for Windows maps your Windows desktop over two or more monitors. When used with the Tornado PCI graphics board, TWIN enables each screen to provide a resolution of 1280 by 1024 pixels in true color or 1600 by 1280 in 65,000 colors. TWIN for Windows includes a utility that lets users configure the system so that any standard Windows software will run on either screen or split across screens as if they were one huge monitor.

Price: £150 (without graphics boards).

Contact: Datapath
Derby, U.K.
+44 1332 294441
fax: +44 1332 290667.
Circle 1343 on Inquiry Card.

MO DRIVE WITH ENHANCED IDE INTERFACE

Fujitsu's M2541 MO magneto-optical storage drive for portable computers is a 17-mm high, 250-gram removable/rewriteable system that uses 3½-inch disks and offers 230 MB of storage. Due to its intelligent power management, the M2541 draws only 0.2 W in sleep mode. An Enhanced IDE interface eliminates the need for a SCSI card and enables connectivity to any PC architecture.

Price: £299.

Contact: Fujitsu Europe
Uxbridge, U.K.
+44 181 573 4444
fax: +44 181 573 2643.
Circle 1345 on Inquiry Card.

ADONIS
Micro-Software

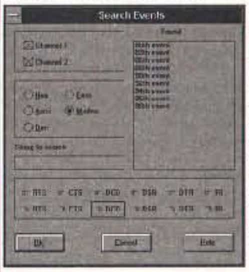
SuperMonitor for DOS , Windows

The flexible and versatile solution for your serial data and protocol analysis. The continous graphic user interface for DOS and Windows* guarantees an easy operation. SuperMonitor is very quickly attached to a serial data transmission and is a silent but watchful observer of the operation.

You are now able to considerably reduce your development time and costs when setting up or monitoring a serial link by using SuperMonitor.

SuperMonitor is able to execute not only simple short measurements but also long day and night runs. In Windows 3.x up to two measurements can run simultaneously using the Twin version.

You even have the possibility as developer to extend SuperMonitor by using *SuperCom* the heart of SuperMonitor.



- flexible software solution
- up to 115 KBit baud rate
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*Windows=Windows 3.x + Windows 95

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RS232-Toolkit, SuperCom for DOS, Windows, OS/2, NT, WIN 95

for MS C/C++, Visual C++, Turbo/Borland C/C++, Turbo/Borland Pascal, Delphi, IBM C/C++, WATCOM C/C++

SuperCom is the development tool for exacting serial communication software. That means high data security and highest transmission speed. The SuperCom libraries are fast even in a multitasking operating system like Windows 3.x, NT, Windows 95 or OS/2. The same programming interface is used among different languages and operating systems.

- Interrupt driven: transmission, reception, linestatus, modem status. Up to 115,200 bps.
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- Simultaneous COM_1..COM_36 (and unlimited).
- Direct register programming*. Interrupt-Sharing.
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- Multitasking support (Windows, NT, WIN95, OS/2)
- User Event Routines under DOS and Windows.
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- Multiserial board support (AST, ARNET, DigiBoard PC/X, HOSTESS, STARGATE). Reduces loading of CPU through support of intelligent DigiBoard PC/Xe, PC/Xem, PC/Xi boards (up to 7 Boards/PC !!!).
- Modem support, RS422/485 support.
- Supports 286 DOS-Extender (e.g. PharLap, Borland)
- NO ROYALTIES. No resident drivers*. Just link the LIB.
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- Full source code (C or Pascal and optimized ASM).
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*Under DOS and Windows. Windows=Windows 3.x + Windows 95 16bit,
NT=Windows NT + Windows 95 32bit

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NEW!!! COMM-Enhancer for Windows 3.x

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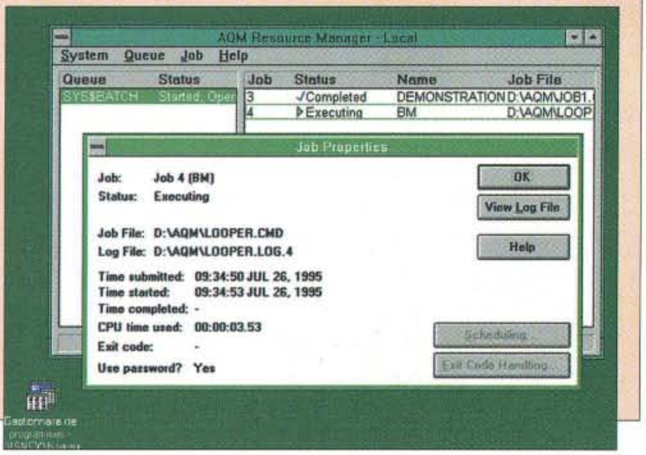
Circle 542 on Inquiry Card (RESELLERS: 543).

WHAT'S NEW Software

MAINFRAME-LIKE JOB SCHEDULING FOR NT

Argent Queue Manager (AQM) 2.3, a batch job scheduler for Windows NT, has features typically found in a mainframe batch job scheduling system. AQM 2.3 has full dependency support, alerting sequences for job failure, and time-zone support. Its Batch Control Language lets you download files from legacy systems. AQM can be installed remotely from a local computer and gives the system manager the flexibility to submit a job under a user's account.

Price: US$1980.
Contact: Sunbelt International
Rueil-Malmaison, France
+33 1 47770500
fax: +33 1 47770299.
Circle 1330 on Inquiry Card.



Queue	Status
SYS$BATCH	Started, Oper

Job	Status	Name	Job File
3	✓Completed	DEMONSTRATION	D:\AQM\JOB1.
4	▶Executing	BM	D:\AQM\LOOP

Job: Job 4 (BM)
Status: Executing

Job File: D:\AQM\LOOPER.CMD
Log File: D:\AQM\LOOPER.LOG.4

Time submitted: 09:34:50 JUL 26, 1995
Time started: 09:34:53 JUL 26, 1995
Time completed: -
CPU time used: 00:00:03.53
Exit code: -
Use password? Yes

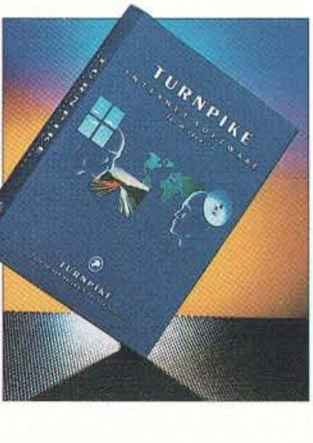
SDK CREATES DOCUMENTS THAT "SPEAK" ITALIAN AND KOREAN

Lernout & Hauspie's Text-to-Speech software development kits are now available in Italian and Korean. The system converts written text in word processing documents, spreadsheets, and databases into natural-sounding speech. With the Text-to-Speech SDK, developers can integrate the technology in Windows 3.1 and Windows 95 applications. The SDK includes a DLL, sample programs, API function reference and language-specific reference guides, and user-defined exceptions dictionaries.

Price: US$1995.
Contact: Lernout & Hauspie
Woburn, MA
(617) 932-4118
fax: (617) 932-9209.
Circle 1323 on Inquiry Card.

INTERNET ACCESS SOFTWARE FOR LANS ▼

Turnpike is an integrated Internet access program for Windows that is designed for dial-up users. It includes E-mail and a news reader as well as FTP, Telnet, Finger, and Ping. With Turnpike, you can have several mailboxes and more than one address. An address book automatically records all E-mail addresses. The multiuser version works on a LAN so that only one file server is required to handle mail and news. Turnpike is MIME-compliant and includes SMTP server, POP3, POP2, and NNTP. The included Winsockets, TCP/IP stack and PPP/SLIP drivers let you access the World Wide Web.



Price: £99 for a single PC;
£249 for a five-user license.
Contact: Turnpike
Dorking, Surrey, U.K.
+44 1306 747747
fax: +44 1306 747749
http://www.sunbelt.co.uk.
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WEBMANAGER PUBLISHING ON THE WEB

Descartes' Webmanager is a new tool for publishing on the World Wide Web. It comprises user-definable data-entry screens with an "HTML merge" function and a customizable editor. Webmanager-designed templates are automatically uploaded to your Web server. A repository tracks all changes to ensure you have a separate update of your work. The vendor claims that Webmanager helps users who are not familiar with HTML run a Web site with a minimum of bother.

Price: Starts at £400.
Contact: Descartes Solutions
Manchester, U.K.
+44 161 953 4114
fax: +44 161 953 4108
http://www.u-net.com/descartes.
Circle 1325 on Inquiry Card.

DATABASE FOR APPLICATION DEVELOPERS ▼

The DTF relational database system for applications developers comes as a library of C/C++ functions and provides dynamic SQL so that the source code is readable even during a debugging process. It uses virtual memory techniques, special cache modules, and a client/server architecture to enhance performance in environments with little memory. DTF uses separate "Workspaces" to process queries simultaneously and includes error recovery as well as backup and restore modules. It runs under DOS, Windows, and OS/2 and supports such 32-bit compilers as Watcom C 9.5, Borland C++, GNU C, and IBM C++ Tools.

Price: Starts at DM 460.
Contact: SLAB
Holzgerlingen, Germany
+49 7031 604449
fax: +49 7031 604223.
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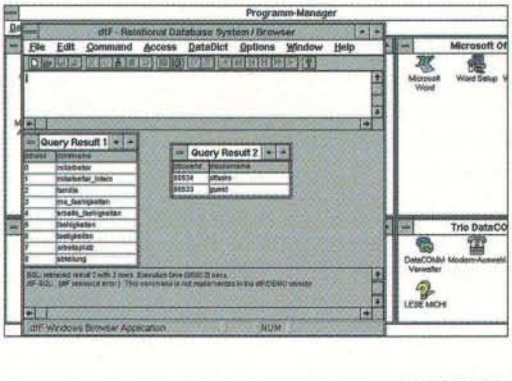

MPEG RECORDING SYSTEM

Easy-CD Video is Windows CD recording software that follows the White Book Video CD specification. It lets you rearrange, add, and delete video clips and reportedly supports all CD recorders currently on the market. With Easy-CD, you can drag and drop MPEG track files from the files manager into the program window. Any connected CD recorder is automatically recognized and installed.

Call for price.
Contact: Incat Systems
Milano, Italy
+39 2 3931 1341
fax: +39 2 3931 1374.
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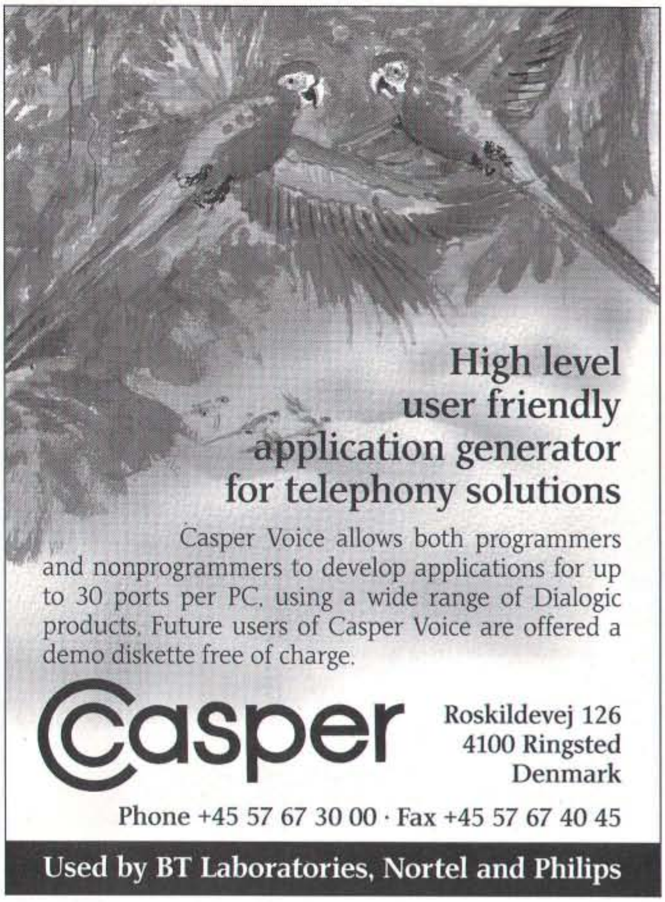

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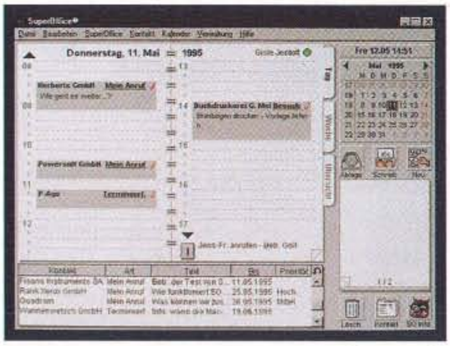

NETWORK-READY CONTACT MANAGEMENT ▲

SuperOffice 3.0 is a network-ready contact management software package for Windows that includes calendar sharing between users, group scheduling, interoffice E-mail, and document image processing. It offers access to corporate databases and linkups to employees in the field. The system works with existing word processors and spreadsheets, so you can continue to use your favorite applications.

With SuperOffice, you can create several projects and track the progress of each, assign internal and external users, and cross link between contact records and the project.

Price: DM 610 for a single user; DM 2430 for a five-user license.
Contact: SuperOffice
Oslo, Norway
+47 22 83 1550
fax: +47 22 83 5590.
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MAXIMIZE YOUR SALES CONTACTS

Maximizer for Windows is a contact management package that offers a complete range of features for client and prospect follow-up. Features include a client database with an unlimited number of contacts per client and unlimited notes on each client and contact level. The software comprises an integrated word processor with spell checker, extensive mail-merge facilities, standard reports, an agenda with "hotlist" features, group scheduling, and automatic action logging. Maximizer is available in a stand-alone or LAN version covering all major network platforms.

The vendor also offers the qualification and forecasting system SalesVision that rates and monitors progress of potential orders and contracts.

Price: Maximizer, £330; SalesVision, £950.
Contact: Nomis
Camberley, Surrey, U.K.
+44 1276 22168
fax: +44 1276 22168.
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SCRIPTED WINDOWS LOG IN TO NETWARE

WinLogin lets you log in to your NetWare LAN directly from Windows and, therefore, offers a Windows replacement for the Novell DOS Login program. WinLogin offers full support of log-in scripts. It features a Windows batch-command processor and supports bindery and NDS. Network Utilities says the software is particularly useful where users rely on asynchronous remote connections to a server.

Call for price.
Contact: Network Utilities
Surbiton, U.K.
+44 181 391 9200
fax: +44 181 391 9233.
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ELECTRONIC FILING FOR YOUR OFFICE

EGAMI is a complete office filing system that includes document image processing and an 8-pages-per-minute scanner. Within each file, you can create up to 26 sections to control and process documents. It lets you rotate, enlarge, and mark images. You can also attach comments and descriptions to documents and images. The system supports optical WORM disks and CD jukeboxes for archiving.

Price: Starts at £1995.
Contact: DP Advisers
London, U.K.
+44 171 834 4068
fax: +44 171 630 7952.
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MULTIMEDIA AUTHORING WITHOUT PROGRAMMING

The SMARTbook for Windows multimedia authoring program includes background-generation tools, a simplified command structure for creating hyperlinks via buttons, and hot area and hot words. It supports AVI video and high-resolution fractally compressed images.

Price: £299; £99 for SMARTbook Lite.
Contact: Frax
Aberdeen, Scotland
+44 1224 621144
fax: +44 1224 620789.
Circle 1335 on Inquiry Card.

SCAN AND CONVERT IMAGE FILES

Sentfactor Image Viewer helps you find images on your PC. It lets you scan the contents of each directory until you recognize the particular image that you want. The Image Viewer not only includes a slide show utility and 200 stock photography images, but it also lets you convert among 15 common file types including BMP, CALS, JPEG, MAC, RAS, and WPG.

Price: US$29.
Contact: Sentfactor
Galway, Ireland
+353 91 94393
fax: +353 91 90644.
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DEVELOPMENT ENVIRONMENT FOR DISTRIBUTED OBJECTS

JBA Guidelines is a software development environment for generating graphical client/server applications for the workgroup up to the enterprise. The latest version, 3.1, introduces a messaging layer that ensures that all applications are object-enabled and, therefore, can be used in object-oriented databases and OSes with minimal amendment. It is targeted at COBOL, Basic, C, and C++ development teams. Guidelines lets you create programs that run on the PC and on the server platform.

The new CORBA-compliant messaging layer provides an interface between object calls and code. The vendor claims that the coexistence of traditional and advanced object technology enables an evolutionary migration from client/server to distributed objects.

Price: Starts at £595.
Contact: JBA
Studley, U.K.
+44 1789 400212
fax: +44 1789 400675.
Circle 1334 on Inquiry Card.

RAD TOOL FOR EMBEDDED SYSTEMS

Nohau's Codewright, a Windows-based programmer's editor for embedded projects, lets you select text by line and column, automatically change a variable name across different files, and open a large number of files with a single command. You can customize Codewright's interface to suit particular menu and command preferences. It also features "CromCoding," allowing color coding of commands, keywords, strings, numbers, and commands.

Price: £185.
Contact: Nohau
Hampshire, U.K.
+44 1962 733140
fax: +44 1962 735502.
Circle 1347 on Inquiry Card.

MULTIMEDIA PRODUCTION TOOLS

MediaShop for Windows offers comprehensive animation, sound editing, and media-integration tools. This multimedia production package is aimed at developers, trainers, animators, and designers who need to create corporate presentations, point-of-sales kiosks, or interactive games. The Motion Editor module provides cell- and path-based animation capabilities. The integrated Paint Program features 24-bit color, onion skinning, and antialiasing. The Sound module offers special effects such as amplify, echo, fade-in, and fade-out in 16-bit stereo quality.

Call for price.
Contact: Gomark Ltd.
London, U.K.
+44 171 731 7930
fax: +44 171 736 1215.
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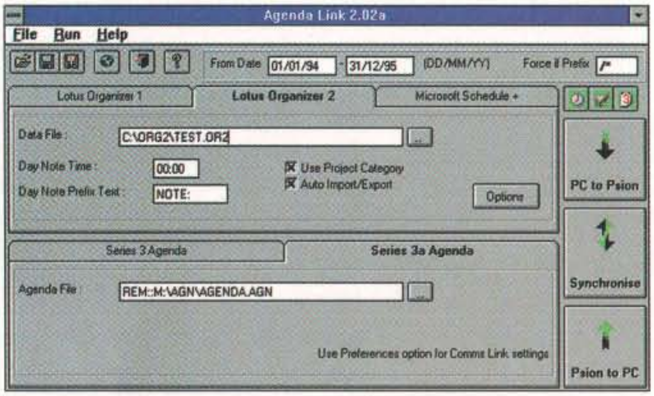

From Date 01/01/94 - 31/12/95 (DD/MM/YY)

Data File: C:\ORG2\TEST.OR2

Day Note Time: 00:00

☒ Use Project Category

☒ Auto Import/Export

Day Note Prefix Text: NOTE:

Agenda File: REM::M:\AGN\AGENDA.AGN

Use Preferences option for Comms Link settings

SYNCHRONIZE YOUR AGENDAS ▲

Agenda Link 2.0 converts and synchronizes information from the Agenda software running on the Psion Series 3 or 3a and Lotus Organizer versions 1 and 2. It lets you convert diary and anniversary data one-way and synchronize two Agendas. You can even save a file directly to the Psion's internal drive.

Call for price.

Contact: Widget Software
Knebworth, U.K.
+44 1438 815444
fax: +44 1438 815222.

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ADD AN ENCRYPTED DRIVE TO YOUR SYSTEM

ZSafe for Windows and DOS creates an additional, secure drive on your PC hard disk. The drive's contents are encrypted and decrypted on the fly. The physical size of the virtual drive is dynamically adjusted and requires only enough space to store the logical contents.

Price: US$199.

Contact: Zincom
Knutsford, U.K.
+44 1565 650383.

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NEW HELP DESK AUDITOR

The Barefoot Auditor—Support Edition helps IT administrators and support staff analyze a PC's configuration. It provides a simple means of identifying all files on a PC and grouping them by function. An expert system analyzes the content of executable files and produces a number of standard reports, including memory managers, mouse and screen drivers, and fonts.

Price: US$277 for a single PC; US$877 for multiple PCs.

Contact: Pathfinder
Stockport, U.K.
+44 161 406 7399
fax: +44 161 406 7410
http://www.u-net.com/pathfinder/.

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WIZRULE ANALYZES DATABASE LOGIC

WizRule for Windows is a new database-auditing tool that discovers rules and errors in a database. It is based on an algorithm that reveals the rules independently and detects deviations from those rules. By focusing on the deviations, you can identify errors in the database contents and correct them. It can produce reports and read Xbase, Paradox, and Access files and other ODBC-compliant databases.

Price: £330.

Contact: Softwerk
Arlesley, U.K.
+44 1462 832244
fax: +44 1462 832288.

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Working in the Code Mine

DENNIS BARKER

It's hell working at Microsoft. Or so it is for the techno-turks in *Microserfs*, a zippy novel about 20-somethings hacking away in Mr. Bill's code mines. In the great work literature of the past, cruelly oppressed laborers slaved in slaughterhouses, sloshing around in guts and gore. These kids are bummed because they have to stay up all night debugging, trying to meet shipping dates, strung out on Chee•tos and Tab, living in fear of being flamed by Bill.

Meanwhile, they exist day by day, line by line, lamenting their lack of personal lives ("my universe consists of home, Microsoft, and Costco"), plotting their escape from Redmond, and being sure to check Microsoft's NASDAQ price.

The main characters are programmers—narrator Daniel works in product testing—but they talk more like industry groupies. They make a few obligatory references to C++ and class libraries, but mostly they talk Silicon Valley trash: the differences between Microsoft and Apple ("better cafeterias" versus "better nerd toys"), the "weird" corporate culture at Intel (staffers are suspected of being cyborgs), gossip, why Windows is counterintuitive, and the Cult of Bill.

ILLUSTRATION: WILLIAM GRAEF © 1995

And they whine, oh how they whine, that they're not "One-Point-Oh"—the first people to work on the first version of something. Being One-Point-Oh is what makes you a Cyberlord rather than a Microserf.

Coupland gets a little too cute sometimes, and his characters tend to talk like sitcom people, always quick with the riposte and bubbling with witty asides. But his observations are dead-on; he's much funnier than anyone writing in the high-tech press. There's a great scene set in a meeting with venture capitalists. Daniel uses pop metaphors to describe the money types. There's "VC Woman with Barbra-Streisand-in-Concert Hairdo" and "Young VC guy, who would be the same age as Rosemary's Baby."

Coupland's treatment of computers is more cultural than technical. They are props rather than an essential part of the story. In fact, he's more interested in the low-tech knickknacks of the social landscape than he is in computing technology. For every reference to a Pentium or the Internet, there are a hundred mentions of warehouse stores, Pop-Tarts, Legos, *Melrose Place*, CNN, and aerosol cheese.

But that's OK. Coupland uses these cultural bits to good effect. Daniel describes his housemates in terms of their dream *Jeopardy* categories. There are enough pop references in this book to fill a CD-ROM on merchandise and entertainment of the late twentieth century.

Coupland's story is only partially about working at Microsoft. Mostly, it's about people and their relationships, not about the epic struggle to link objects. It's all seen through the eyes of 20-year-olds, but don't let that scare you away. The concerns here are universal: family, friends, and making a living.

Compared to some of the great work novels, *Microserfs* doesn't have the weight of Upton Sinclair's *The Jungle*, and it doesn't have the low-down grit and pathos of Charles Bukowski's *Post Office*. But it's a pretty good story, sometimes touching, often funny, and it's a very entertaining chronicle of life in these weird times. ■

MICROSERFS

Douglas Coupland
Regan Books/HarperCollins
ISBN 0-06-039148-0

$21

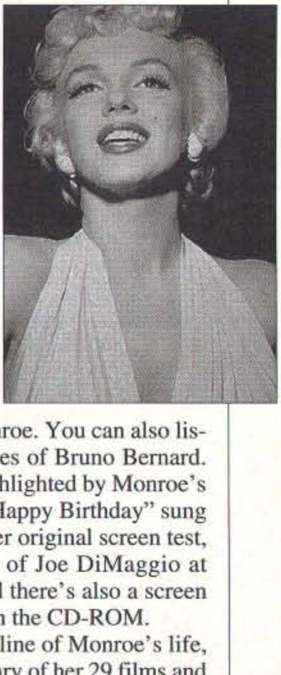
Dennis Barker has never worked in a code mine, but he's held a variety of editing positions at BYTE. You can reach him on the Internet or BIX at dbarker@bix.com.

MARILYN REMEMBERED

BERNARD OF HOLLYWOOD'S MARILYN

Corel Corp., 1600 Carling Ave., Ottawa, Ontario, Canada K1Z 8R7, (613) 728-8208, $69.95

I have always had a fondness for Marilyn Monroe. After all, we share the same birthday (June 1). But my fondness never turned into the fascination that many die-hard fans have for the platinum blonde beauty. Bernard of Hollywood's Marilyn (which works on Macintosh System 7.0 or Windows 3.1 or higher) traces her life from the early days as Norma Jean to that tragic day (August 5, 1962) she died. The disc is based on a book of the same title by Susan Bernard, daughter of renowned Hollywood photographer Bruno Bernard, often described as the "discoverer of Marilyn Monroe."



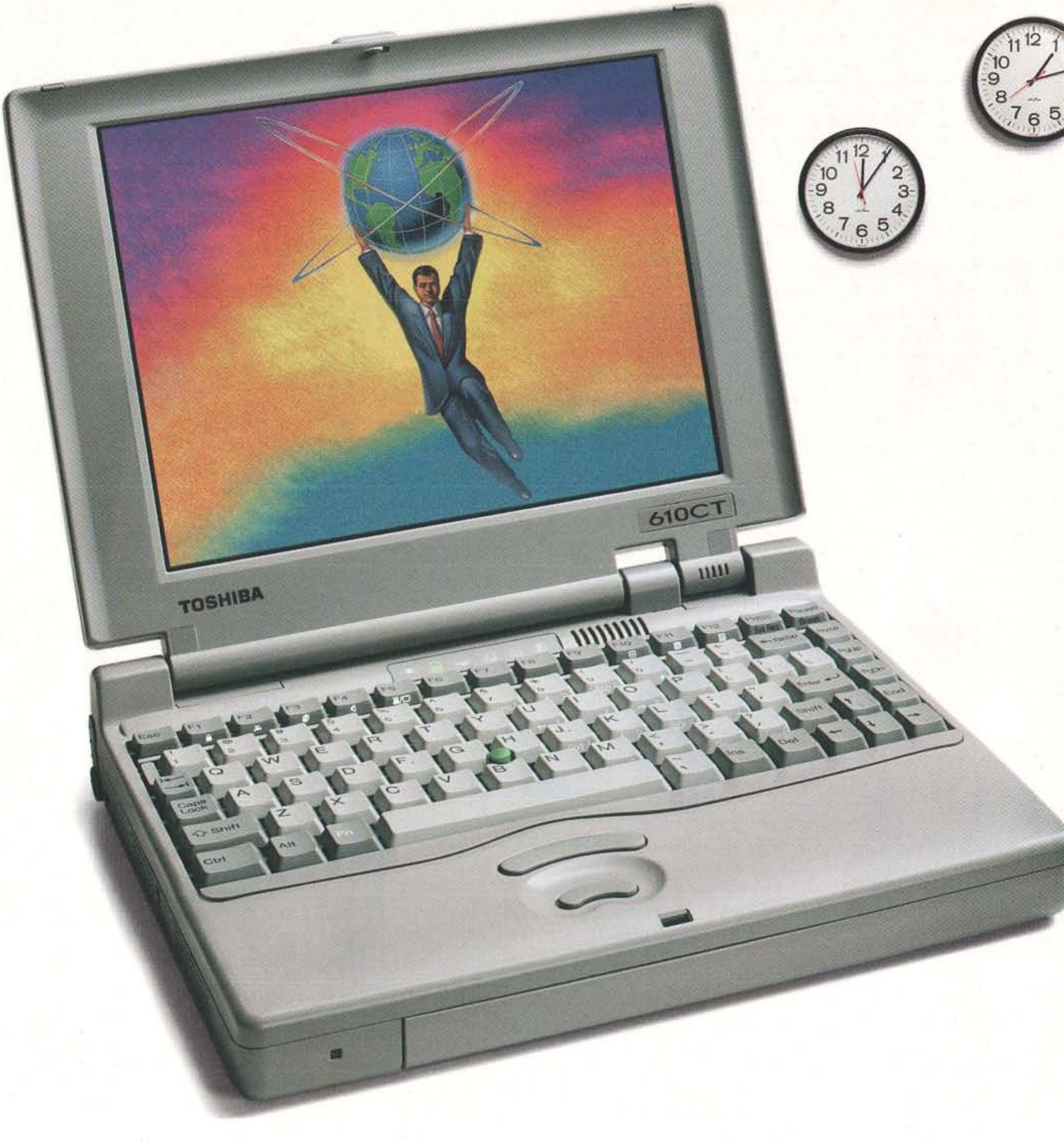
Accompanied by a jazzy 1950s sound track, you can page through Susan Bernard's text, which offers links to audio and video clips of Monroe. You can also listen to the journal entries of Bruno Bernard. The video clips are highlighted by Monroe's famous rendition of "Happy Birthday" sung to John F. Kennedy, her original screen test, and newsreel footage of Joe DiMaggio at Monroe's funeral. And there's also a screen saver of, guess who, on the CD-ROM.

You also get a time line of Monroe's life, which includes a glossary of her 29 films and a list of 103 "essential" Marilyn Monroe facts. Only the truly obsessed fan would care that Monroe had a weakness for chocolate éclairs, that her dress size was 12, and that her favorite snack was caviar.

I was, however, impressed with Bruno Bernard's photographs of Monroe. The disc includes a number of his works, and it's easy to see how they helped Monroe become a legend.

As the cake comes out and my family begins to sing, I'll remember Monroe, but don't ask me to tell you that her pant size was nine.

—*Jeff MacClay*



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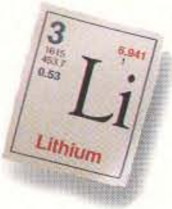

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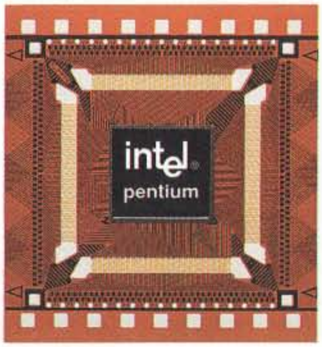

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THE NEW PC

Four new technologies will usher your next PC into the '90s

TOM R. HALFHILL

Don't be fooled by fast CPUs: The PC of 1995 is little more than a souped-up IBM AT from 1984, which was a minor improvement over the IBM PC of 1981, which was based on technology from the 1970s that wasn't so hot to begin with. Fortunately, that's all about to change.

Some differences will be externally obvious. Think sleek shapes in black or Caribbean colors. Imagine a collection of compact components and a svelte LCD. Reliable voice recognition is on its way. Cables will give way to infrared beams. And built-in video cameras will let your PC stare back at you.

But to really appreciate the new PC, look under the hood. New technologies will unleash the full potential of modern operating systems and microprocessors, and performance bottlenecks from albatrosses like the ISA bus will disappear. Four of these technologies are available now: Plug and Play (PnP), universal serial bus (USB), unified memory architecture (UMA), and native signal processing (NSP). Together, these technologies will create a more integrated PC that is easier to configure, has significantly faster I/O, uses memory more efficiently, offers more features without extra hardware, and costs relatively less than today's equivalent systems.

The new PC won't make its debut with fanfare and fireworks. Rather, it will evolve steadily over the next five years (see "Old PC vs. New PC," page 55). Here's what to expect during that evolution.

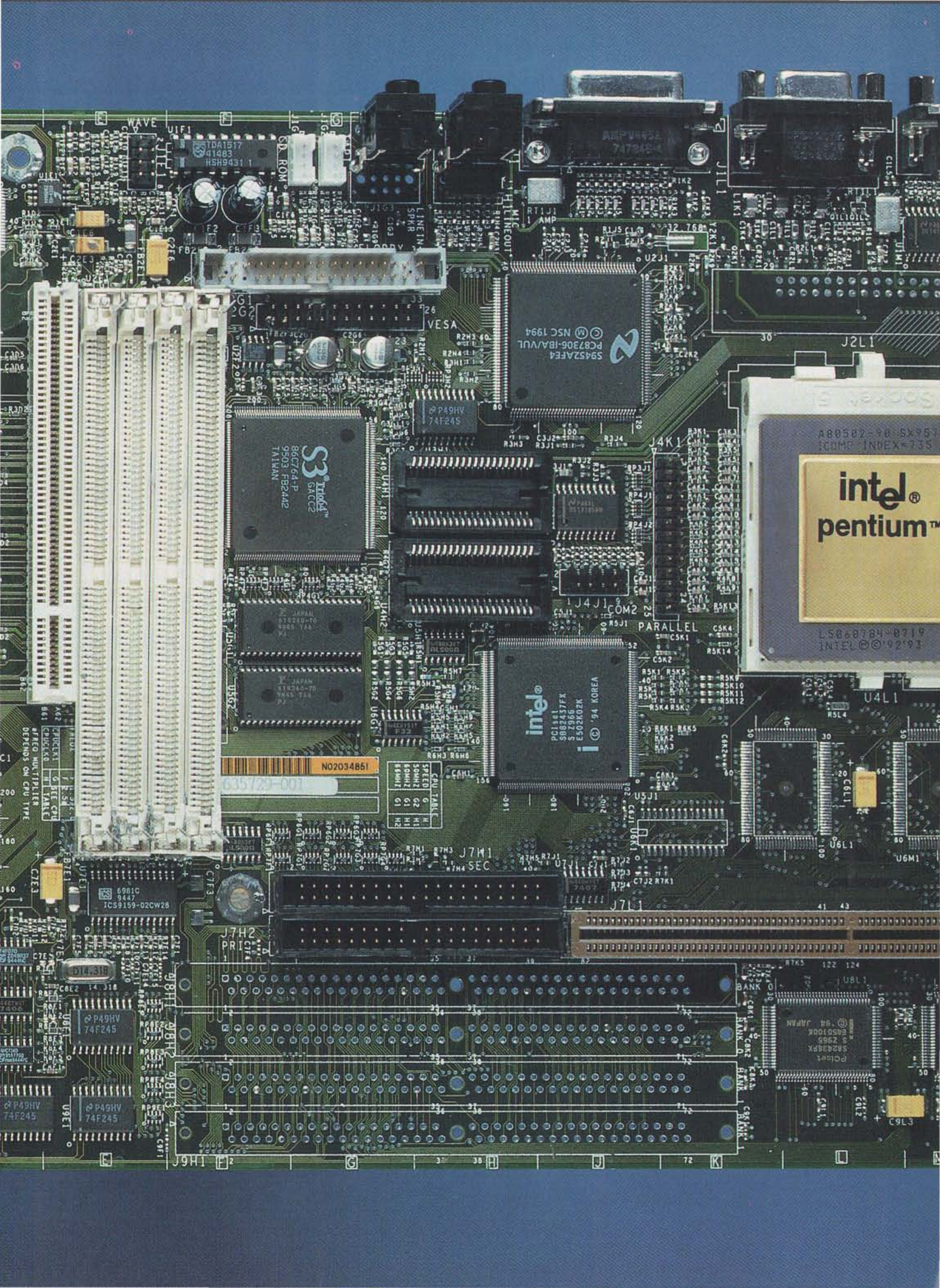
Still Praying for Plug and Play

To see tomorrow's PC, look at today's Macintosh. Macs are far from perfect, but they have pioneered many technologies now coming to PCs. Plug and play has been standard since the 1980s, along with reasonably fast and easy-to-use I/O interfaces such as SCSI and the Apple Desktop Bus (ADB). Numerous Macs employ a unified frame buffer/memory architecture, and Power Macs use NSP for some telephony applications. Moreover, the latest Power Macs are the first mainstream computers to discard their legacy I/O bus (in this case, NuBus) in favor of PCI.

Playing catch-up with Apple, however, is not what PC designers have in mind. The goal is to leapfrog the Mac by adopting superior versions of these technologies whenever possible. Leading the charge are Intel and Microsoft, who may be the only companies powerful enough to direct wholesale changes in the industry. (See the text box "Intel and Microsoft: The Agents of Change," page 58.)

PnP is high on Microsoft's agenda because it's probably the most glaring remaining difference between a PC and a Mac. Although Windows 95 is loaded with PnP features (the Device Manager, dynamic configuration, the Add New Hardware Wizard, and more), they aren't much help if the computer and peripherals don't support PnP as well. Without a PnP BIOS and PnP devices that cooperate with each other and with the OS, painless system expansion will remain just slightly out of reach (see "Transforming the PC: Plug and Play," September 1994 BYTE).

Fortunately for long-suffering PC users, there's strong movement toward PnP. All signs point to wide adoption of PnP throughout the industry in 1996, even if the only mo-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tivation for some vendors is to control their skyrocketing technical-support costs.

All along, Apple has preached the gospel that hardware and software must be tightly integrated. Unfortunately for Apple, it's hard to sell this integration as a feature precisely because it's so transparent. It was easy for Apple to achieve this level of integration because, until recently, the Mac was a closed, proprietary system available only from Apple.

Ironically, as the PC becomes more like a Mac, a Mac may become more like a PC, since Apple now is licensing the Mac OS to clone makers and porting it to the PowerPC common hardware platform.

Port Power

USB represents another major improvement in PC architecture. This external I/O interface will begin appearing in commercial desktop systems next year. If it succeeds, USB could eventually replace a whole slew of ports on today's PCs. This won't happen immediately, because the huge installed base of PCs impedes rapid change. Nevertheless, I/O bottlenecks will push PC vendors to add an interface designed with 1990s technology.

Venerable RS-232 serial ports offer speeds of from 9.6 to 115.2 Kbps, depending on the type of universal asynchronous receiver/transmitter (UART) in the computer. USB's maximum bandwidth is 12 Mbps—although actual data throughput is more like 8 Mbps—including a 1-Mbps subchannel for low-speed devices like a mouse or keyboard. That's enough bandwidth to handle everything from keyboards and mice to video monitors, modems, scanners, printers, ISDN adapters, and MPEG-2 compressed video.

In addition, USB is both asynchronous and isochronous. Isochronous transfers, such as audio and video, get top priority, assuring that time-sensitive data streams are not interrupted. USB lets you daisy-chain up to 127 devices in a tiered-star topology: Each device can house a USB hub to which additional devices can connect. Cable segments can be 5 meters long. It supports hot-plugging, so you can add or remove devices without powering down the computer. If the devices and the OS support PnP, the appropriate device drivers can automatically load and unload.

USB is also cheap to implement. Some of Intel's PCI chip sets will soon include USB logic, so the only additional cost is for the 35-cent external connector. As

ON THE COVER

Now that PC architecture is being overhauled (see main story), how different will your next PC look? Our cover shows three possibilities: The Apple Sweep and IBM Leapfrog are industrial designs, while the Archistrat 4b was scheduled to ship commercially as we went to press. All three are significant because their capabilities, as well as their external design, are made possible by the new technologies being incorporated by the next generation of PCs.

Sweep designer Tim Parsey says the flat-panel display inspired Apple to create a desktop system built around components that are smaller and thinner than conventional PCs, but offer the same computing power as the stacked boxes we're used to working with. Inside the Sweep is a standard motherboard that can house next-generation PowerPC chips. The keyboard tucks away into the horizontal stand. The main vertical segment holds CD-ROM, hard-disk, PC Card, and floppy drives. Built-in audio gets a boost from two tweeters and detached external speakers.

The Leapfrog also uses the LCD to break the bounds of the desktop mold. The portable display panel holds the CPU, as well as the hard-disk, floppy, and PC Card drives. The pen stylus and pen-based software launche applications. For a more traditional desktop unit, attach the LCD panel to the docking station (nicknamed the lily pad), which features a slide-out keyboard.

The Archistrat Systems 4s and 4b computers use a custom connector that sits between a partitioned motherboard and a passive backplane. The architecture lets you mix and match CPUs, I/O subsystems, and other fundamental components to accommodate your needs (for details, see the text box "Coming Soon: Archistrat 4s," on page 60).

Coming Soon

ATX Motherboards

Intel's new ATX motherboard is the first major reengineering of the PC motherboard in a decade. It sets a new standard for motherboard configuration for desktops and mini-towers that improves the component layout. ATX also costs less to manufacture; provides easier access to slots, cables, and bays; reduces noise and power consumption by requiring only one cooling fan and a smaller power supply; and fits existing AT and baby AT cases. It also fits into a new small-footprint case that stacks the rear connectors to save even more space. The ATX will appear in PCs later this year. Contact: Intel, Santa Clara, CA; (800) 538-3373 or (408) 765-8080; http://www.intel.com/pc-supp/platform.html or /motherbd/atx.html. **Circle 1075 on Inquiry Card.**

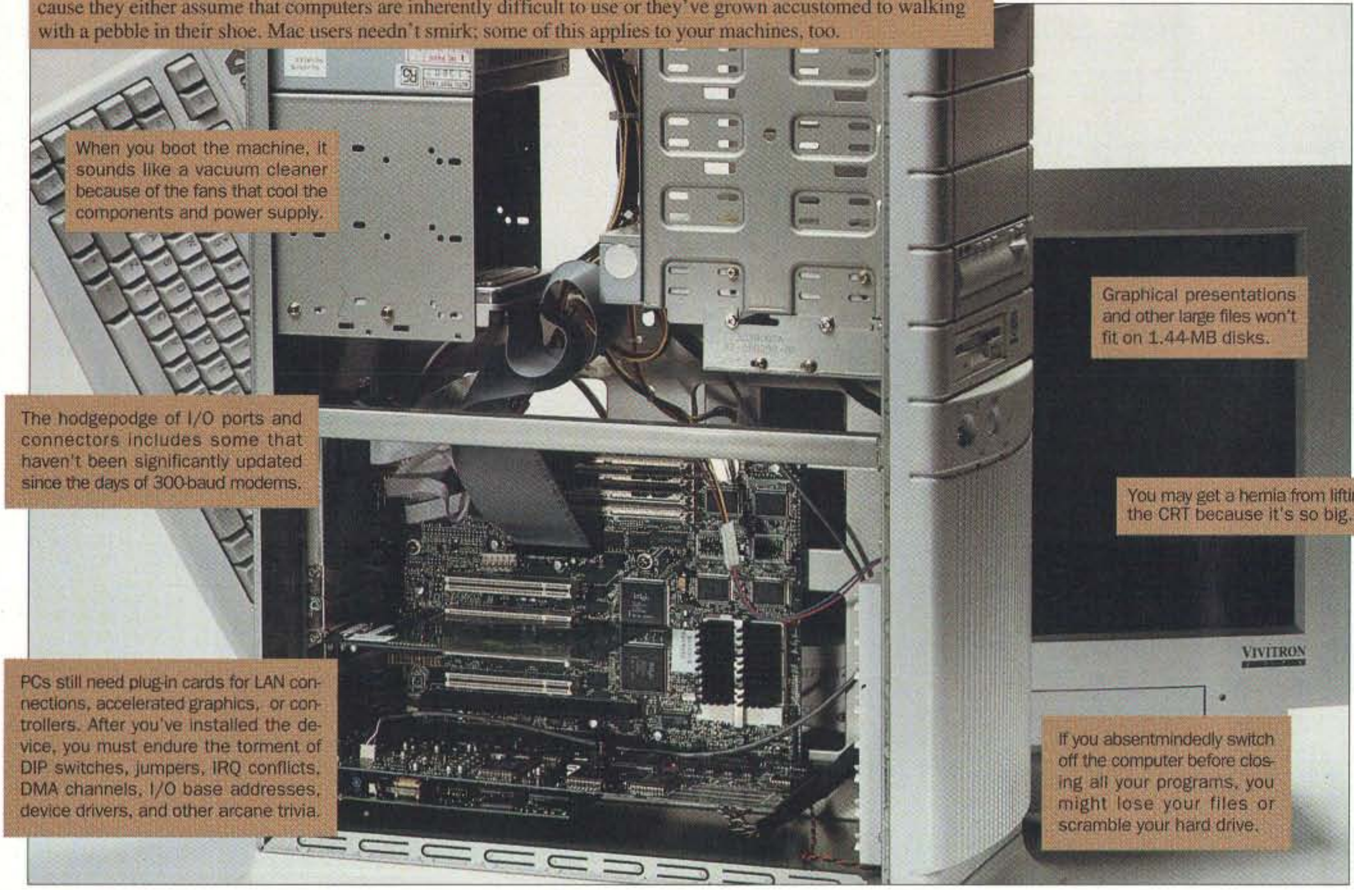
Now Showing

Jabra-Net Telephony

The Jabra-Net $99 package includes Jabra's Ear Phone, AlgoRhythms' PC Phone program, and VocalTec's Internet Phone software that turns your PC into a hands-free telephone that can place global long-distance voice calls over the Internet for the cost of a local call. The Jabra Ear Phone is a clever gadget all by itself—it fits in your ear and picks up your voice with a unidirectional mike concealed in the earpiece. Contact: Jabra, San Diego, CA; (800) 327-2230, (619) 622-0764, or fax, (619) 622-0353; sales@jabra.com; http://www.jabra.com. **Circle 1079 on Inquiry Card.**

OLD PC

Take a fresh, hard look at the PC on your desk. Many users don't notice what's wrong because they either assume that computers are inherently difficult to use or they've grown accustomed to walking with a pebble in their shoe. Mac users needn't smirk; some of this applies to your machines, too.



When you boot the machine, it sounds like a vacuum cleaner because of the fans that cool the components and power supply.

The hodgepodge of I/O ports and connectors includes some that haven't been significantly updated since the days of 300-baud modems.

PCs still need plug-in cards for LAN connections, accelerated graphics, or controllers. After you've installed the device, you must endure the torment of DIP switches, jumpers, IRQ conflicts, DMA channels, I/O base addresses, device drivers, and other arcane trivia.

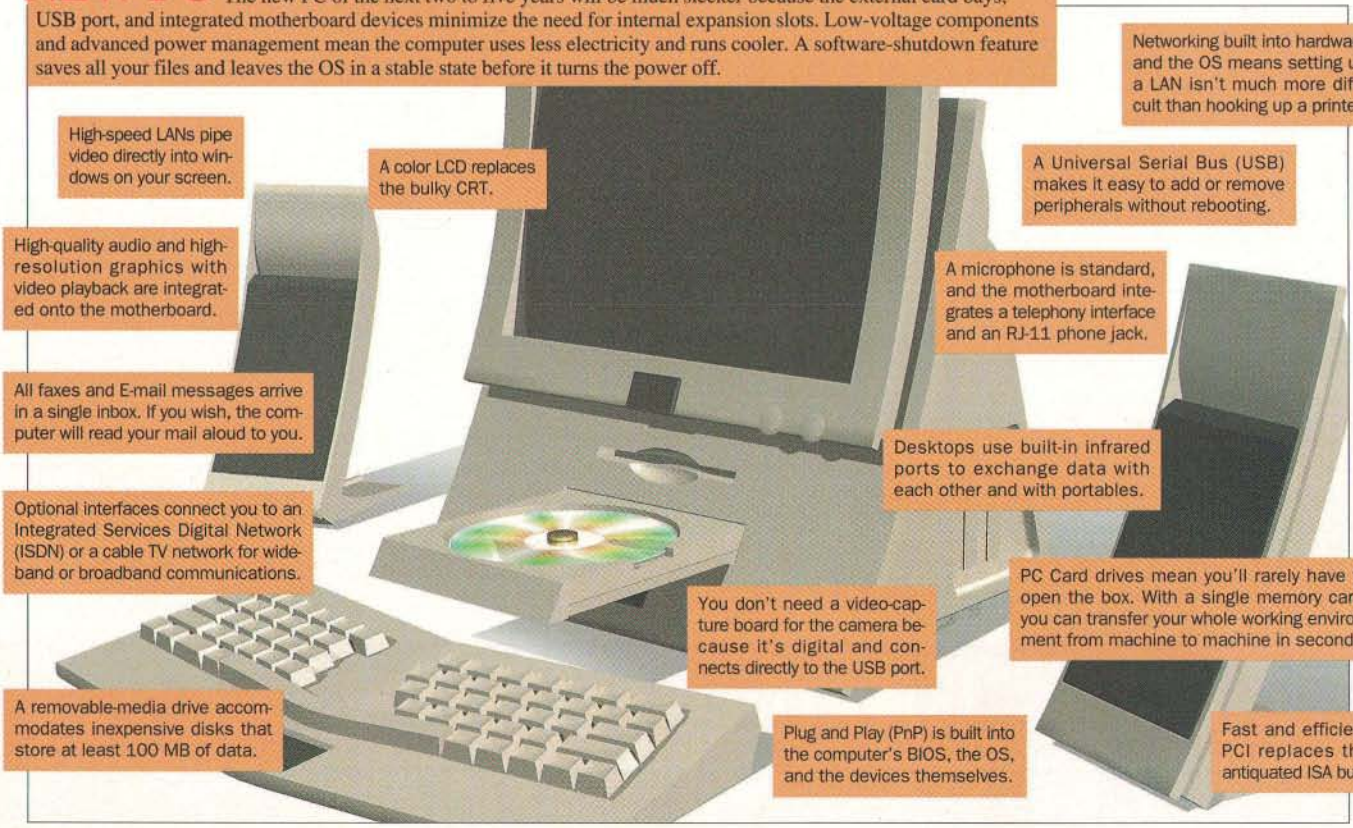
Graphical presentations and other large files won't fit on 1.44-MB disks.

You may get a hernia from lifting the CRT because it's so big.

If you absentmindedly switch off the computer before closing all your programs, you might lose your files or scramble your hard drive.

NEW PC

The new PC of the next two to five years will be much sleeker because the external card bays, USB port, and integrated motherboard devices minimize the need for internal expansion slots. Low-voltage components and advanced power management mean the computer uses less electricity and runs cooler. A software-shutdown feature saves all your files and leaves the OS in a stable state before it turns the power off.



Networking built into hardware and the OS means setting up a LAN isn't much more difficult than hooking up a printer.

High-speed LANs pipe video directly into windows on your screen.

A color LCD replaces the bulky CRT.

A Universal Serial Bus (USB) makes it easy to add or remove peripherals without rebooting.

High-quality audio and high-resolution graphics with video playback are integrated onto the motherboard.

A microphone is standard, and the motherboard integrates a telephony interface and an RJ-11 phone jack.

All faxes and E-mail messages arrive in a single inbox. If you wish, the computer will read your mail aloud to you.

Desktops use built-in infrared ports to exchange data with each other and with portables.

Optional interfaces connect you to an Integrated Services Digital Network (ISDN) or a cable TV network for wideband or broadband communications.

PC Card drives mean you'll rarely have to open the box. With a single memory card, you can transfer your whole working environment from machine to machine in seconds.

You don't need a video-capture board for the camera because it's digital and connects directly to the USB port.

A removable-media drive accommodates inexpensive disks that store at least 100 MB of data.

Plug and Play (PnP) is built into the computer's BIOS, the OS, and the devices themselves.

Fast and efficient PCI replaces the antiquated ISA bus.

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other chip makers incorporate USB into their products, the new serial bus will become a standard feature on new PCs. Inexpensive USB might also encourage engineers to include USB hub logic in external peripherals, which would provide for extra USB ports for daisy-chaining additional devices. Cables have only four wires, allowing compact connectors roughly as wide as a staple. Small size is important for notebooks, palmtops, and downsized desktop PCs. For all these reasons, USB appears to be edging out alternative I/O interfaces that have been proposed as the next-generation standard, including GeoPort, Access.bus, FireWire, and SCSI.

GeoPort is a slightly enhanced version of the 12-year-old RS-422 serial ports on Macs. Apple already equips Power Macs with GeoPorts to provide telephony functions. For instance, the GeoPort Telecom Adapter connects a phone line to the Mac while the PowerPC processor emulates a fax modem. Apple formed a consortium called Versit with IBM, AT&T, and Siemens to promote GeoPort as an industry standard, and it will be available for PCs in the form of PCI and PC Cards (formerly PCMCIA). However, GeoPort's relatively slow throughput of 2 Mbps probably eliminates it from contention as the next-generation external I/O port for PCs.

Access.bus is even slower than GeoPort—its data rate is only 100 Kbps. Invented by Philips, it was never intended to be a general-purpose high-speed interface. Instead, it was designed for low-speed peripherals, such as keyboards and pointing devices. It's also used for the Video Electronic Standards Association (VESA) Display Data Channel (DDC), a control interface for video monitors that Microsoft recommends for future PCs. But even though Access.bus costs less to implement in peripherals and on motherboards, its inability to support a wide range of peripherals puts it at a disadvantage with USB.

FireWire—officially known as IEEE-P1394—is backed mainly by Apple, with chip support from Texas Instruments. It has significant advantages over USB. FireWire's data rate is 100 Mbps and will soon be extended to 200 Mbps and 400 Mbps. Also, FireWire is being promoted as a standard interface for consumer video devices, such as digital VCRs and cameras. If widely adopted, it could accommodate much faster peripherals than USB and provide the crucial digital link between personal computers and future con-

INTEL AND MICROSOFT: THE AGENTS OF CHANGE

Finding faults in the PC is not the problem; fixing them is. The basic architecture of PCs remained stagnant for a decade because IBM lost control of the standard in the 1980s and nobody else was strong enough to claim the position of top dog.

Even the leading clone vendors like Compaq, Packard Bell, Gateway 2000, and Dell don't wield enough influence to force fundamental changes. Besides, profit margins are too slim to fund the costly R&D that's required to make it happen.

Result: a power vacuum that has attracted Intel and Microsoft. Both industry giants are frustrated by the problems of the PC system architecture. Intel wants to keep the PC market growing in order to sell more chips; Microsoft wants to ensure that PCs will be powerful enough to support its future ambitions for Windows. Their motivations are self-serving, but in the end, the whole industry will benefit if the result is more efficient systems.

Intel built a lavish R&D facility in Hillsboro, Oregon, known as the Intel Architecture Lab (IAL). In effect, IAL is playing the same R&D role for penny-pinching clone vendors that Bell Labs used to play for the regional Bell telephone companies.

IAL is responsible for inventing, refining, or promoting technologies that either fix problems in the PC architecture or create new applications that accelerate demand for PCs. These technologies and products include PCI, Universal Serial Bus (USB), Plug and Play (PnP), Telephony API (TAPI), Display Control Interface (DCI), Native Signal Processing (NSP), Digital Simultaneous Voice & Data (DSVD), ATX motherboards, Indeo video compression, ProShare videoconferencing, and CNN at Work.

Microsoft has been playing a key role in developing such hardware/software technologies as PnP, USB, TAPI, and DCI. Recently, Microsoft has been going even further. In a bold imposition for a software company, Microsoft sponsors a yearly confab (the Windows Hardware Engineering Conference, or WinHEC) and publishes an inch-thick manual ("Hardware Design Guide for Windows 95") that instructs hardware companies how to design their future PCs and peripherals. To win the coveted Windows 95 logo, system vendors must follow Microsoft's specifications, right down to putting little icons on the back of the computer so users can tell the mouse port from the keyboard port.

It's hard to imagine a "WordPerfect Hardware Engineering Conference" or a "Hardware Design Guide for After Dark," but then, other companies are not Microsoft. While programmers at other software companies write to the hardware, Microsoft is redefining the hardware around Windows.

Of course, Intel and Microsoft don't always see eye to eye—they've split over such things as DCI and NSP—but in general, they share the same goal: Fix the PC.

Coming Soon

NeoMagic MagicGraph NM2070

Highly integrated components offer more functionality while cutting costs and reducing power consumption. NeoMagic's new MagicGraph NM2070 is a single chip that replaces three or four separate chips in notebook systems, integrating a Super VGA graphics accelerator, a 1-MB frame buffer, a 128-bit memory interface, a RAM digital/analog converter (RAMDAC), an LCD controller, and PCI/VESA local-bus interfaces. The first notebooks with the MagicGraph NM2070 will be announced this fall. Contact: NeoMagic, Santa Clara, CA; (408) 988-7020, or fax (408) 988-7032; info@neomagic.com; http://www.rahul.net/neomagic.

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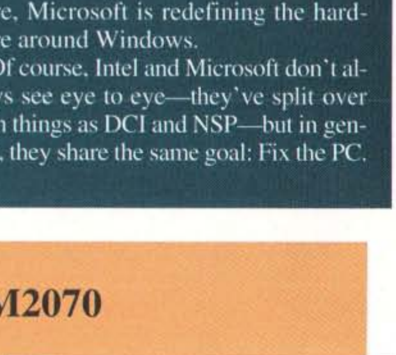

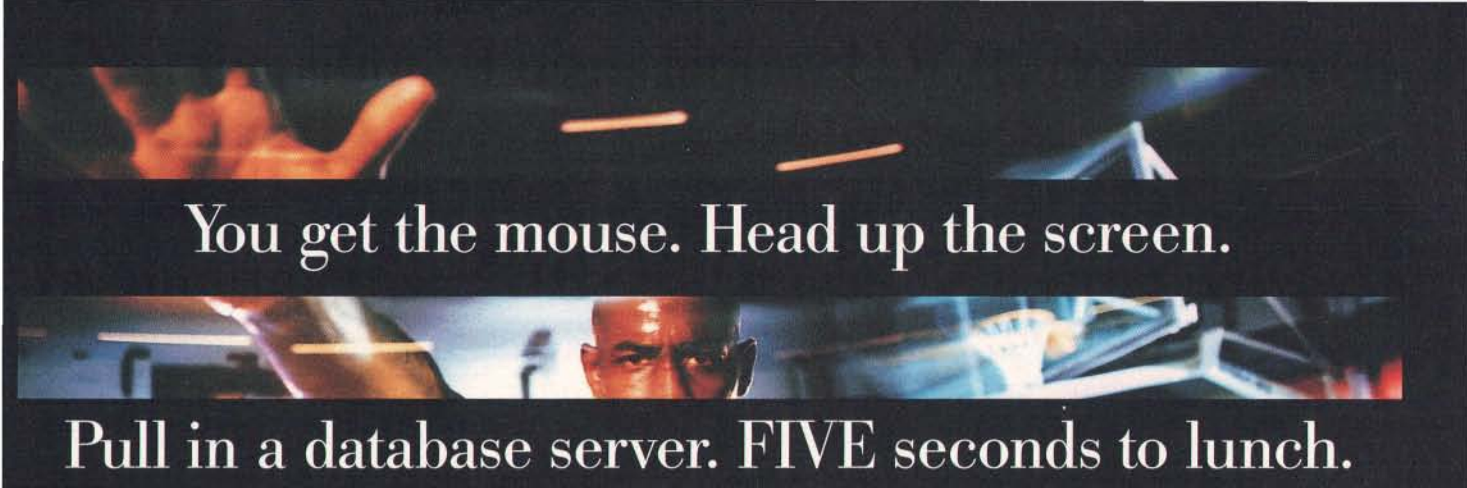
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sumer electronics products.

But because FireWire logic isn't inherent in chip sets and peripherals, it costs more to implement than USB. Apple has yet to build FireWire into any of its Macs, and it's even less likely to be integrated in PCs. It will probably be available on a PCI board for those who want it in 1996.

SCSI remains a contender. When Apple standardized on SCSI in 1986, it spawned a healthy market for SCSI-based scanners, hard disks, CD-ROM drives, and other peripherals. When PC users began upgrading their systems with CD-ROM drives, SCSI adapters zoomed in popularity. Today, SCSI is an important cross-platform interface standard that's also found on some Unix workstations. SCSI-2 introduced faster throughput in two flavors. Fast SCSI-2 doubled original SCSI speeds to 10 Mbps on an 8-bit bus. Wide SCSI-2 can use a 16- or 32-bit bus for throughput of 20 Mbps. Fast and Wide SCSI achieves speeds of 40 Mbps.

But SCSI has several problems. Current implementations support only eight devices per chain, far fewer than rival serial interfaces. Each end of the daisy chain must be terminated, a prime cause of configuration woes. Each device requires a unique ID number, and some devices don't support all IDs. Because SCSI is a parallel interface, the connectors are relatively large, the cables are thick and expensive, and longer cable lengths are unreliable. SCSI doesn't allow hot-plugging, either.

Work is progressing on new versions of SCSI to address these flaws. The proposed SCSI-3 standard calls for more than eight devices per chain, automatic ID assignment, and faster throughput. There are even proposed serial versions of SCSI-3 that could use fiber-optic cables or gallium arsenide technology to attain speeds as high as 1 Gbps. So SCSI still has a bright future as the high-speed alternative in applications that need peripherals that would quickly saturate the capacity of USB.

RAM Reunification

Since the original IBM PC of 1981, almost all PCs have maintained separate memory for their frame buffer, the block of memory in which the screen image is mapped. This wasn't a problem in the days of monochrome character-mapped video because the frame buffer could be as small as 2 KB. But modern GUIs have created demand for high-resolution, true-color bit-mapped screens. A 640- by 480-

Coming Soon

Archistrat 4s

One of the most unconventional system architectures seen in recent years is coming in a new line of servers and desktop systems from Panda Project, a start-up based in Boca Raton, Florida. Panda partitions the traditional motherboard into three independent boards connected to a passive backplane by a proprietary high-speed interface. By separating the CPU, I/O, and main memory into modular subsystems, Panda says it will offer a level of upgradability and CPU independence unmatched by conventional designs.

The CPU board includes the microprocessor, secondary cache, primary PCI bus, and related control logic. (For now, Panda is supporting three CPU architectures—Intel x86, DEC Alpha, and soon IBM/Motorola PowerPC—but others could be added in the future.) The I/O board includes system I/O interfaces, such as ISA, SCSI, or a bridge to a second PCI bus. The memory board contains all the DRAM for main memory. These subsystems connect to the backplane with Panda's high-density Compass interface, a panel of 18 152-pin connectors.

This architecture allows users or resellers to snap together their own systems with the CPU, I/O interfaces, and memory they want.

Panda's first system, the Archistrat 4s server, is expected to debut this fall at $10,490. That's for a 100-MHz Pentium with 32 MB of RAM and a 1-GB hard drive. Alpha CPU boards are planned for later this year, and PowerPC boards based on the PowerPC common hardware platform are expected in mid-1996.

Archistrat's modularity lets you start with a Pentium and switch to an Alpha, or vice versa.

"It's intellectually satisfying," says Eric Lewis, an analyst at International Data Corp. (Mountain View, CA). "But I don't think most companies are really that interested in switching [CPU] architectures, because then you've got to revamp all your software, too. It seems like a fairly small market."

It's also a market pursued by DeskStation Technologies, which last year introduced a motherboard called the UniFlex. The UniFlex segregates the CPU on a daughtercard that supports either an Alpha 21164 or a Mips-compatible R4600 Orion. (Future versions may also support the Alpha 21164A and the PowerPC 620.) DeskStation puts the UniFlex motherboards into its high-end PCs for Windows NT.

Panda goes further than DeskStation by partitioning the I/O and memory subsystems as well. Conceivably, you could swap out the memory board to take advantage of faster DRAM technology or change the I/O board if a new bus standard supersedes PCI.

DeskStation's vice president of engineering, Blaise Fanning, says Panda's design is philosophically sound but unnecessary in practice, because memory and I/O technologies don't advance as quickly as CPUs. Also, he adds, by the time you upgrade all the subsystems, you might as well purchase a whole new computer: "The only investment you're really preserving is the backplane."

Previous passive-backplane designs have also been criticized for their high cost or inadequate bandwidth. Panda says its Compass technology solves these problems. The Compass connectors carry about 650 signals between the CPU and the backplane, but they cost only five cents per mated pair, according to Bruce Smith, Panda's vice president of engineering.

BYTE was unable to test a production sample of the Archistrat 4s in time for this article. If nothing else, Panda's modular approach to motherboards is an interesting twist on the system architecture of PCs. Contact: Panda Project, Boca Raton, FL; (800) 892-2892, (407) 994-2300, or fax (407) 994-0191; sysinfo@archistrat.com. **Circle 1083 on Inquiry Card.** DeskStation Technologies, Lenexa, KS; (800) 793-3375, (913) 599-1900, or fax (913) 599-4024 http://www.dti.com; sales@dti.com. **Circle 1084 on Inquiry Card.**

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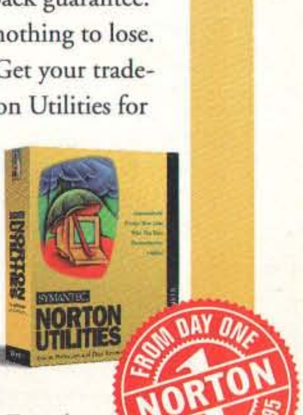

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Circle 110 on Inquiry Card.

pixel screen with 8-bit color requires a frame buffer of 300 KB; 1024 by 768 pixels with 24-bit color requires 2.25 MB.

It's not just an issue of more memory. A dedicated frame buffer is fixed in size—no matter which screen mode you're using, the frame buffer always contains enough memory to accommodate the highest resolution and color depth it supports. Your software can't use the leftover memory. Because of the way DRAM is packaged and configured in graphics subsystems, megabytes of memory can go to waste.

UMA unifies the frame buffer with main memory. By allocating just enough RAM to handle the current screen mode, UMA frees up memory for other purposes. Eliminating the dedicated frame buffer is expected to trim about $50 off the cost of a typical system. Chip sets that support UMA are coming from Weitek, Opti, VLSI, Chips & Technologies, Intel, and Cirrus Logic. PCs with UMA should appear this year or early in 1996.

In all likelihood, UMA will come first to low-end PCs. High-end systems will probably avoid it, because UMA sacrifices performance when the CPU and the graphics controller try to access main memory at the same time. Cirrus Logic estimates the performance hit is about 5 percent for a 16-MB system with a secondary CPU cache, and 10 percent to 15 percent for cacheless systems. An 8-MB system would suffer more. Reduced performance is why Apple, which has used a similar scheme for years, still retains dedicated frame buffers in some Macs.

Mixed Signals

Still up in the air is how PCs will handle signal-processing tasks, such as audio, video, and telephony. This question pits Intel against some other chip makers and against Microsoft.

PCs have taken advantage of general-purpose digital signal processors (DSPs) for years. In 1992, Atari introduced the Falcon030, the first personal computer with a general-purpose DSP. Then Apple built AT&T's 3210 DSP into the Quadra 660AV and 840AV Macs. IBM and Texas Instruments announced the low-cost MWave DSP for PCs. And Microsoft said Windows 95 would have a DSP Resource Manager Interface (RMI), an API layer designed to insulate programmers from DSP-specific features.

But the trend was derailed. First Apple, then Intel, claimed its latest CPUs could handle many DSP tasks natively.

Now Showing

Sceptre Desktop LCDs

It'll probably be 10 years before color LCDs challenge the dominance of CRTs on desktops, but you don't have to wait that long—if you're willing to pay. Active-matrix and dual-scan color LCDs for desktop PCs are here now. Sceptre's LCD monitors range in size from 10.3 to 11.4 inches (diagonal), are less than 2 inches thick, and weigh less than 3 pounds. Prices range from $1595 to $2395. Contact: Sceptre Technologies, City of Industry, CA; (800) 788-2878, (818) 369-3698, or fax (818) 369-3488. **Circle 1080 on Inquiry Card.**

Now Showing

Connectix QuickCam

Whiteboarding and document-sharing are the most useful commercial applications for videoconferencing, but visual images will find a place, too. The Connectix QuickCam (about $99) transmits a low-resolution gray-scale image and plugs directly into a parallel port on a PC or a serial port on a Mac, so it doesn't need a video digitizer. In five years, little cameras like this could be as common in PCs as built-in microphones are in today's Macs. Contact: Connectix, San Mateo, CA; (800) 950-5880, (415) 571-5100, or fax (415) 571-5195; connectix@aol.com. **Circle 1082 on Inquiry Card.**

Coming Soon

120-MB Disks

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Windows 95 is here. And it's really terrific.

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Norton AntiVirus for Windows 95 is NCSA certified to detect 100% of the viruses found in circulation. And recent independent tests* conclusively demonstrate that Norton AntiVirus for Windows 95 detects and destroys as many or more known viruses as any other anti-virus product around.

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Full 32-bit application. Supports long file names and Universal Naming Conventions.

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Virtual device driver unobtrusively checks for viruses in the background. Ensures backups and files transferred are virus-free.

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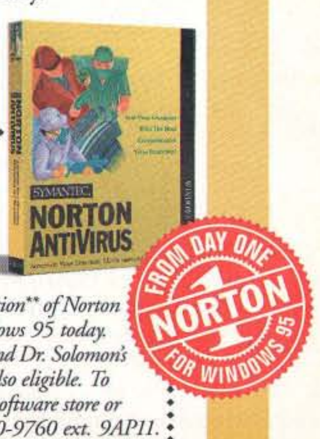


*If you own Norton AntiVirus, Central Point Anti-Virus, Norton Desktop for Windows, or PC Tools, get your $29.95 trade-up edition** of Norton AntiVirus for Windows 95 today. McAfee VirusScan and Dr. Solomon's Anti-Virus owners also eligible. To purchase, visit your software store or call us at 1-800-450-9760 ext. 9AP11.*

*Independent tests conducted by NCSA and VSUM, July 1995. **Trade-up editions will run only when specified Symantec, Central Point, McAfee or Dr. Solomon's products are already installed. Check with your software store for qualifying versions. Price does not include shipping & handling or any applicable sales tax. Symantec and Norton AntiVirus are registered trademarks of Symantec Corporation. All other brand names or trademarks are the property of their respective owners. ©1995 Symantec Corporation. All rights reserved. Visit us on the Internet at http://www.symantec.com. In Canada, call 1-800-365-8641. In Australia, call 2-879-6577. In Europe, call 31-71-353111.

Circle 111 on Inquiry Card.

Apple's GeoPort Telecom Adapter eliminates the need for a modem by connecting the Mac directly to a phone line while using the CPU to emulate a modem in software.

Intel is carrying the concept even further by defining an NSP reference platform for PC vendors and extending the functions to include wave-table audio and software-only video playback. Instead of handing off those functions to dedicated chips and special hardware, Intel's NSP approach uses the CPU to perform audio and video tasks. Intel has demonstrated a 90-MHz Pentium system that uses NSP to display full-motion video in two separate windows while playing eight independent audio tracks.

Partly for these reasons, Microsoft dropped RMI out of Windows 95 and turned it over to Spectron Microsystems, which makes SPOX, a real-time DSP kernel. The lack of a DSP API built into the industry's leading OS is a setback to the widespread integration of DSPs.

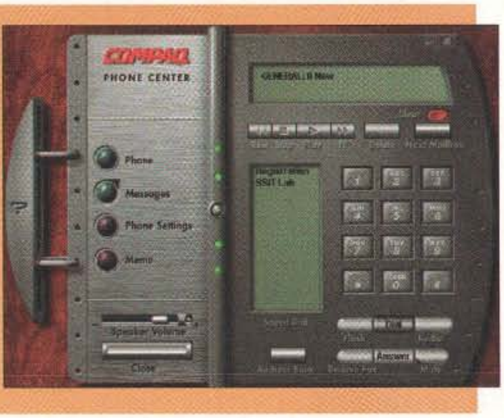
In the view of Compaq and other systems vendors, NSP is a cost-effective technology for delivering speech, audio, and other multimedia functions to the business market. But not everyone is ready to shelve DSPs. "The functions that NSP can provide by using the host [CPU], a few dollars' worth of hardware can provide," says Raphael Mehrbians, a senior product manager at Cirrus Logic.

Also, some of that extra hardware is needed anyway, even with NSP. For backward compatibility with DOS programs, PCs need a Yamaha OPL-3 sound chip. The Pentium's wave-table sounds won't be heard unless there's a standard audio codec chip, such as a Crystal Semiconductor 4232. And even though a Pentium can handle such modem functions as data compression and communications protocols, DSP promoters like TI question whether the best use for a high-end CPU is to emulate the modem's data pump.

So general-purpose DSPs may yet appear on PC motherboards, or perhaps be integrated in future CPUs, just as FPUs were. Intel is known to be developing a "multimedia Pentium" (code-named the P55C) for release in 1996. It is expected to add new instructions for signal processing, but at press time details were not available. It may have a multiply-accumulate function or special instructions for decoding MPEG video—a feature introduced last year in the UltraSPARC processor from Sun Microsystems (Mountain View, CA).

Now Showing

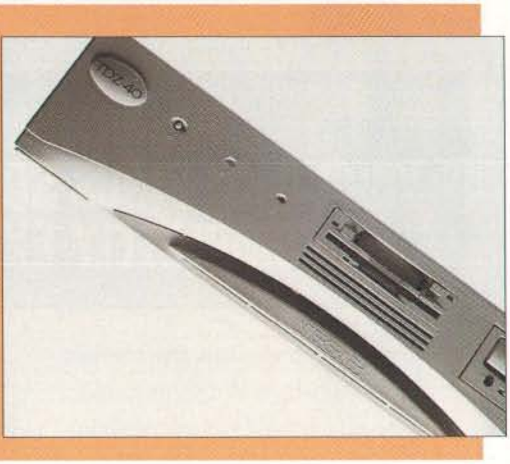
Integrated Telephony



Built-in telephony is now standard in desktop PCs from several vendors, most notably AT&T, Compaq, and Packard Bell. Typically, these PCs come with the hardware and software required to work as speakerphones, answering machines, voice mailboxes, and fax machines (with fax-on-demand).

Now Showing

Intergraph TD/TDZ Workstations



Desktop PC Cards allow easy plug-and-play expansion without opening the system, and you can share cards with mobile computers. Contact: Intergraph Computer Systems, Huntsville, AL; (800) 763-0242, (205) 730-5441, or fax (205) 730-6188; http://www.intergraph.com/ics. **Circle 1077 on Inquiry Card.**

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False starts and growth spurts will buffet the PC industry as it juggles the conflicting issues of cost, performance, and compatibility. Yet change is essential as the competition for desktops becomes fiercer. By mid-1996, expect systems that support the PowerPC common hardware platform, which is backed by IBM, Motorola, and Apple, and designed with the benefit of hindsight.

When PCs were primarily used for word processors, spreadsheets, and databases, the original IBM system architecture was adequate. But multimedia and richer data types have exposed shortcomings in PCs. For the last few years, the industry has been patching the old architecture to keep it competitive. Now the architecture is finally getting the overhaul it really needs. ■

Tom R. Halfhill is a BYTE senior news editor based in San Mateo, California. You can reach him on the Internet or BIX at thalfhill@bix.com.

THE TOP 10 REASONS WHY NORTON NAVIGATOR USERS WORK FASTER IN WINDOWS 95.

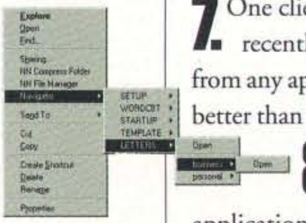
Congratulations! You're the proud owner of Microsoft's Windows 95 operating system. Working on a PC has never been easier.

Now try these ten easy exercises and see how you can work even better and faster in Windows 95 with the all-new Norton Navigator.™

~~CLICK.~~
~~CLICK.~~
~~CLICK.~~
CLICK.

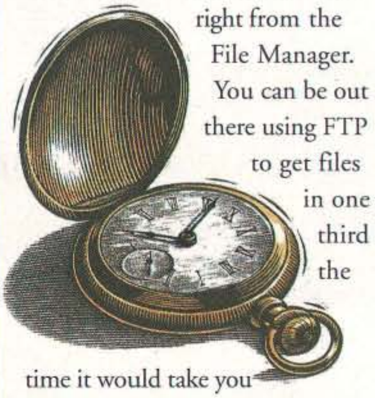
1. First, copy a file from one directory to another. Okay, now copy another file. On average, it takes about eleven steps per file. Now copy a file with Norton Navigator. Mission accomplished. One step.

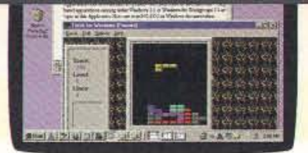
2. Opening a folder in Windows 95 takes a full five clicks of your trusty mouse. But with Norton Navigator, you can open any folder with just one simple click.



3. Compress a file. Our built-in PK-Zip compatible compression saves you a minute every time.

4. Use Norton Navigator to plug into your Internet connection right from the File Manager. You can be out there using FTP to get files in one third the time it would take you with a separate application.





5. Try a word search for "profits" or any other text string within files. It's at least ten times faster on average with Norton Navigator. No matter how many files you have. Or how big they are. In fact, the bigger the files, the more time you'll save.

6. Save another minute every time you delete, move, zip, or encrypt from any application's Open or Save dialog box. (Are you keeping count?)

7. One click is all it takes to access recently opened files or folders from any application. Now isn't that better than wading through folders?

8. Launch your favorite files, folders, or applications simply by pushing a button on the Norton Taskbar. No more going up and down to and from the Start menu over and over again.

NORTON NAVIGATOR FOR WINDOWS 95

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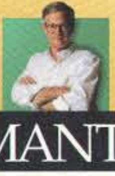
Norton Folder Navigator lets you open, copy, move or create a shortcut for any folder with just one mouse click.

Norton Taskbar features multiple desktops that let you organize your files and find your work faster.

Norton FastFind performs specific text string searches at least ten times faster than Windows 95.



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9. With Norton Navigator, you can create a different desktop for each project. So you can find your work more easily. And save even more time.

10. Windows 95 supports long file names for all of your new 32-bit applications. Norton Navigator supports long file names for most 16-bit applications, too. So you'll never again have to remember what "billgbox" means.

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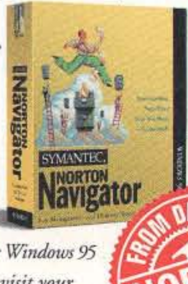

If you own Norton Desktop, PC Tools, XTree, or Norton Commander, get your $39.95 trade-up edition of Norton Navigator for Windows 95 today. To purchase, visit your software store or call us at 1-800-450-9760 ext. 9AP12.*

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FOR WINDOWS 95

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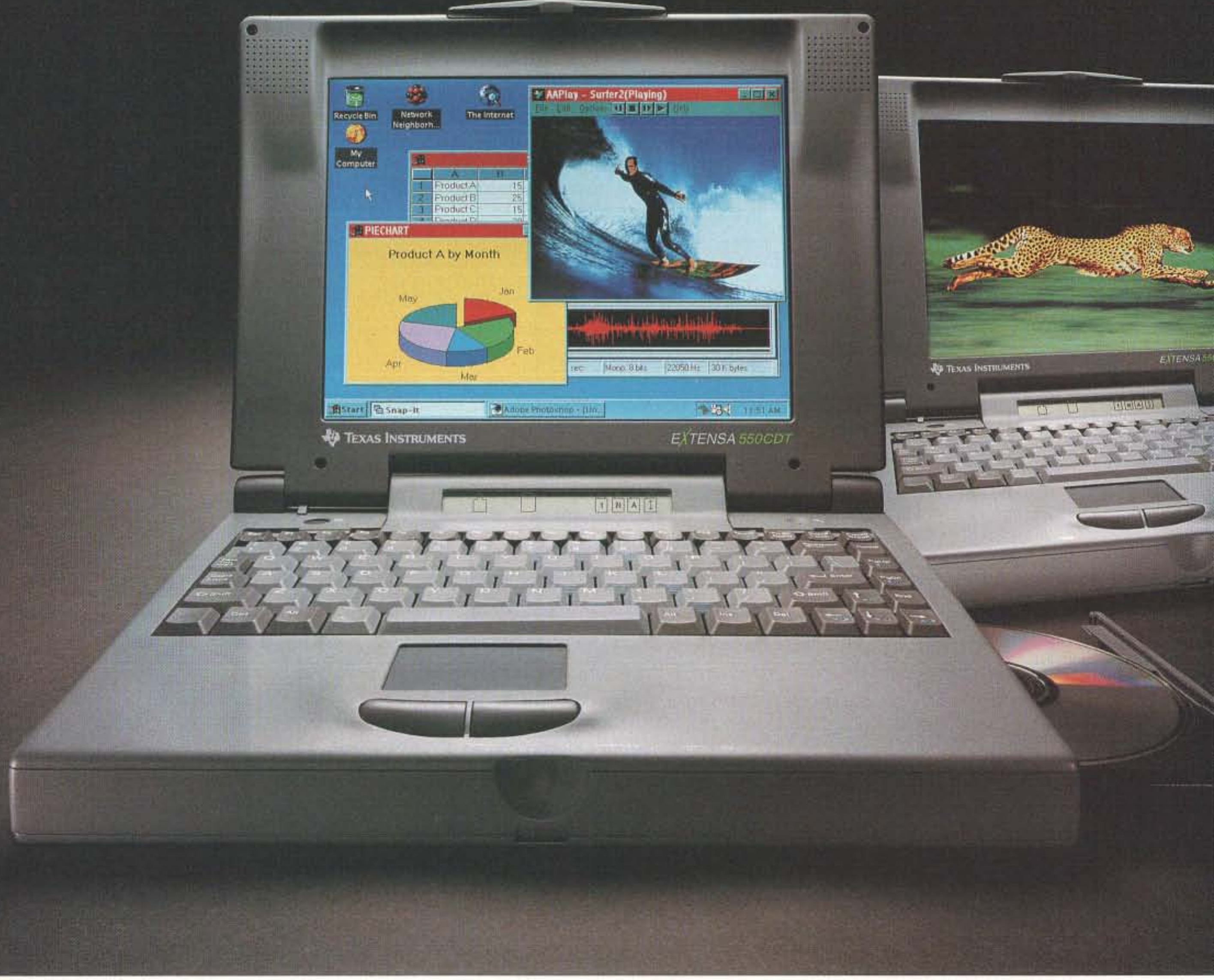
INTRODUCING
IT'S MORE MACHINE



intel inside
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PCI BUS

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EXTENSA

EXTENSA 450

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- 4MB RAM, upgradeable to 32MB
- Serial infrared port

EXTENSA 550

- Pentium 75MHz
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EXTENSA 550CD

- Pentium 75MHz
- Integrated CD-ROM and 16-bit sound
- 10.4" Active Matrix (TFT) or 10.4" Dual Scan display
- 8MB RAM, upgradeable to 40MB
- Serial infrared port

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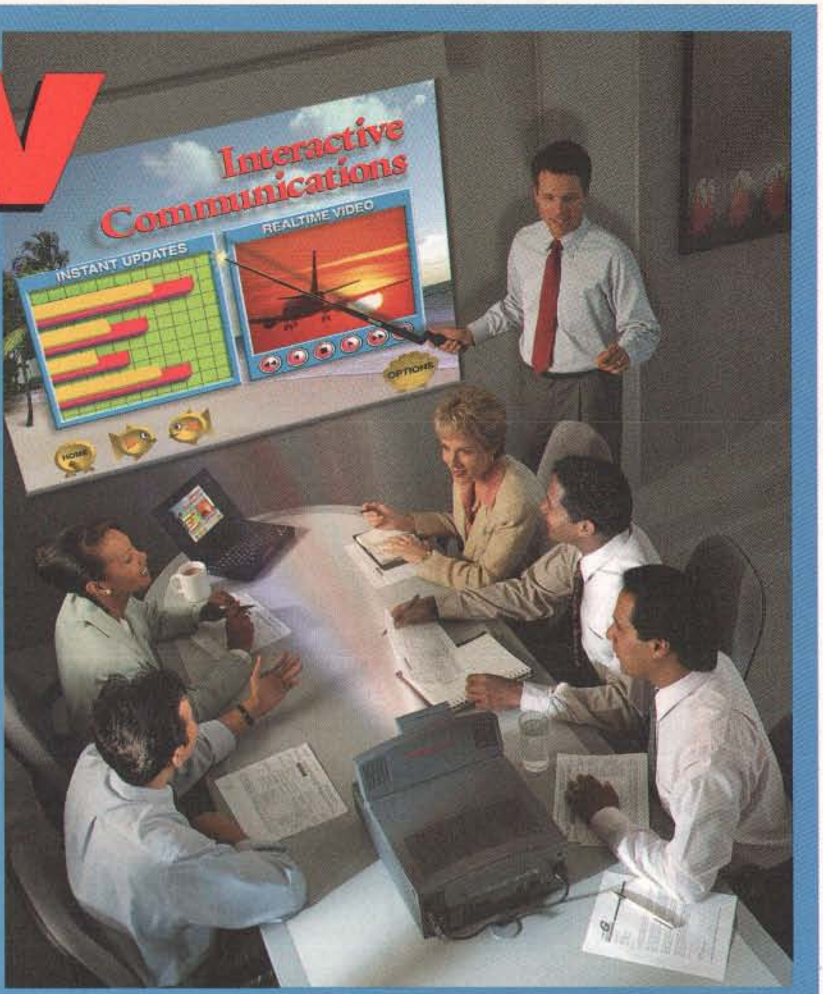
TEXAS INSTRUMENTS

Circle 103 on Inquiry Card (RESELLERS: 104).

HOW TO KEEP YOUR AUDIENCE



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Circle 115 on Inquiry Card (RESELLERS: 116).

Face to Face

ANDREW W. DAVIS

At the 1964 New York World's Fair, AT&T showed the videophone, which delivered voice and video over standard telephone lines. Thirty years later, the newest videoconferencing products from AT&T Microelectronics still use standard telephone lines. But there's a difference.

Videoconferencing has finally shed its proprietary shackles. In 1964, AT&T was the last company to lose sleep over interoperability concerns: The original videophone had to communicate only with other AT&T products. But today, deregulation is the rule and interoperability is a serious issue. AT&T's latest-generation conferencing system can communicate with systems from other vendors. The AT&T system and competitors from Intel and PictureTel are an outgrowth of the sometimes acrimonious interoperability battles of the past two years.

But the battles are ending and the standards war is nearly won: By the end of the year, the International Telecommunications Union's H.324 standard should be formalized. H.324 defines how videoconferencing should work over plain old telephone service (POTS) lines and complements H.320, which does the same for ISDN. These standards could bring videoconferencing to general business applications.

KEN COFFELT © 1995

Videoconferencing systems from different vendors can now talk to each other, thanks to a standard called H.32x

Person to Person

Today's desktop videoconferencing (DVC) systems link the computers of collaborating workers (see the text boxes "In Your Face" on page 70 and "Face Off" on page 72). This is a fundamental difference from group videoconferencing, where participants gather in rooms that are connected to other videoconferencing centers. DVC systems keep collaborators in touch with important data that's accessible from their desktop systems.

According to a 1994 survey by Forward Concepts, a market researcher based in Tempe, Arizona, DVC most commonly connects workers within the same company. To date, most collaborative users have been in aircraft, automotive, and other industries with intensive engineering efforts that require visual communication among numerous workgroups. Intercompany videoconferencing requires standards to solve interoperability and networking issues.

Visions of ubiquitous videoconferencing existed even before the videophone turned heads at the World's Fair. The breakup of the standards logjam in recent months is cause for optimism over the technology's commercial potential. The ITU ratified H.320 in 1990 to cover switched digital networks. H.320 covers a wide range of network bandwidths. Audio signals can range from 16 to 64 Kbps. The video specification spans from one 64-Kbps ISDN link to 30 inverse-multiplexed 64-Kbps ISDN links.

But many vendors resisted H.320 and claimed their own algorithms offered better video quality. H.320 gained widespread acceptance last spring once the Intel-led Personal Conferencing Working Group backed off from its competing proposal based on

Intel's Indeo compression family.

However, H.320 is tied to ISDN, which is excellent technology for sending video but remains mired in rollout problems (see "Implementing ISDN," April BYTE). Attention now is moving to the other networks that connect PCs and workstations. H.324 is significant because it will eventually use a newer compression algorithm than that of H.320 and because it leverages the latest price and performance advances in silicon to promise high levels of audio and video quality. Like H.320, H.324 covers audio, video, and call-control procedures (see the figure "What's Under the H.32x Umbrella" on page 71).

Both H.320 and H.324 are umbrella standards; they don't define technologies in themselves but specify the collection of ITU standards for digital and analog networks. In addition to POTS, the ITU is developing new recommendations for guaranteed-bandwidth packet-switched networks, such as IsoEthernet, and non-guaranteed packet-switched networks, such as ordinary Ethernet.

The Big Squeeze

The essential element in both standards is the H.261 video codec specification, a video-compression algorithm designed specifically for videoconferencing. Like MPEG, H.261 compresses images using discrete cosine transform (DCT). H.261 allows systems to fully encode certain key frames and encode only the differences among other frames. The main elements of the H.261 source coder are prediction, block transformation (spatial to frequency domain translation), quantization, and entropy coding. Here's how it works.

H.261 divides images into 8- by 8-pixel blocks and into macroblocks consisting of four luminance blocks and two corresponding chrominance blocks. The H.261 encoder starts by compressing and quantizing data to form *intramode* blocks; an intramode macroblock must be transmitted at least once every 132 frames in a process known as *forced updating*. The encoder also decodes results and subtracts the resulting image block (which is what the receiver sees) from the input video. If the differences are small, the block is not transmitted.

If there has been sufficient change, the encoder transforms, quantizes, entropy-encodes, and transmits the differences. The definition of "sufficient change" can vary from block to block. Change typically results from motion, but transmission noise can cause the video system to falsely infer change. As a result, commercial

In Your Face

Desktop videoconferencing (DVC) products are available for Windows, Macintosh, and Unix machines for circuit-switched digital WANs (ISDN), circuit-switched analog WANs (POTS), and packet-switched LANs.

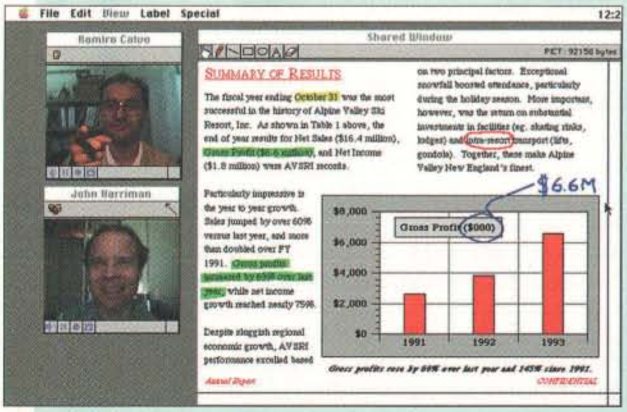
H.320-compliant videoconferencing kits typically include a camera, a microphone/telephone handset, a codec, an ISDN interface board, and data-conferencing software. They range in price from $1500 to $2000. The lower-priced kits may use software for decompression or for both compression and decompression. Because software solutions rely on the host computer's processor, the faster the CPU, the better the performance users will see.

ISDN service providers may offer kits for less than $1000 as part of a service-contract bundle. You can also purchase DVC systems in the form of high-end computers with videoconferencing hardware and software already installed. This tends to be the most expensive alternative, with prices hitting $6000.

ISDN Choices

AT&T, Intel, and PictureTel offer complete H.320 kits for ISDN-based conferencing under Windows. AT&T's Vistium 1300 system includes a dedicated processor for compression/decompression; the less pricey Vistium 1200 relies on the host processor for decompression. Both are available as board kits or prepackaged with AT&T desktop systems.

Intel's Proshare, which recently added H.320 support, uses the host CPU for decompression. PictureTel Live PCS 100 features a high-quality audio connection and full-duplex speakerphone.



SUMMARY OF RESULTS

The fiscal year ending October 31 was the most successful in the history of Alpine Valley Ski Resort, Inc. As shown in Table 1 above, the end of year results for Net Sales ($16.4 million), Gross Profit ($6.6 million), and Net Income ($1.8 million) were AVSRI records.

Particularly impressive is the year to year growth. Sales jumped by over 60% versus last year, and more than doubled over FY 1991. Gross profits increased by 69% over last year, while net income growth reached nearly 75%.

Despite sluggish regional economic growth, AVSRI performance excelled based on two principal factors. Exceptional snowfall boosted attendance, particularly during the holiday season. More important, however, was the return on substantial investments in facilities (eg. skating rinks, lodges) and intra-resort transport (lifts, gondola). Together, these make Alpine Valley New England's finest.

Gross profits rose by 69% over last year and 145% since 1991.

Annual Report

CONFIDENTIAL

Apple's QuickTime Videoconferencing and competing products from Sagem USA bring H.320 support to the Mac.

PictureTel's Live PCS 100 kit supports ISDN and includes a camera, a full-duplex speakerphone, and software.

Vivo Software, which announced the first software-only H.320 codec, offers TeleWork-5, a less expensive superset of the original Windows product. The package now includes workgroup software, Internet access, remote LAN access, and fax modem emulation.

Many OEMs use Zydacron H.320 boards, which support 128- to 384-Kbps communications. Zydacron offers a low-level videoconferencing application as well as hooks for other, more comprehensive collaborative software packages.

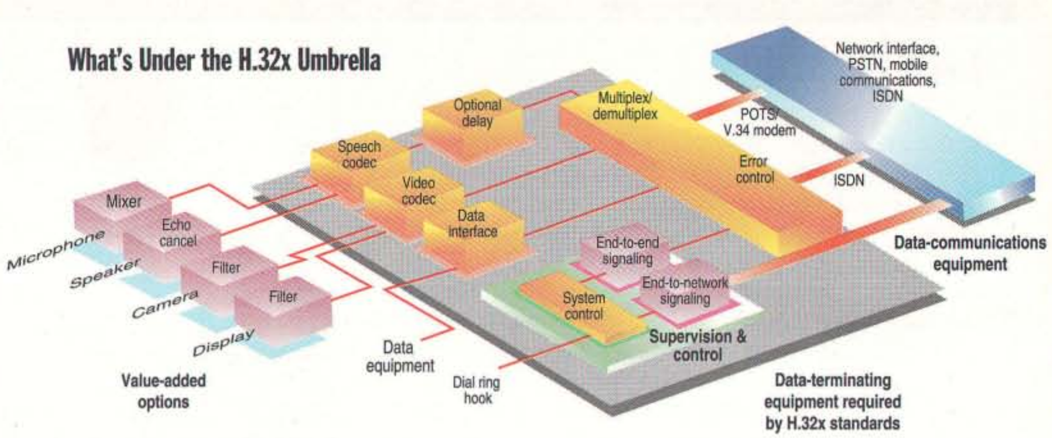
Macintosh users can find H.320-compliant solutions from Apple, which supports the standard within the QuickTime extensions to the Macintosh OS. Sagem USA sells a NuBus H.320 codec board and separate ISDN board.

Gone to POTS

The upcoming H.324 standard and the new chips that perform the H.263/G.723 codec functions promise to combine improved quality with the convenience of POTS. Today, Creative Labs has both PC

H.261 products can offer video-signal noise filters to differentiate themselves from the competition, although these filters are outside the scope of the standard.

What's Under the H.32x Umbrella



The H.320 and H.324 recommendations for videoconferencing terminals (center area) specify the means for audio and video coding, call control, and interfacing to data equipment. The standards include base-level requirements as well as optional specifications. Value-added opportunities (on the left) such as sound mixing, noise filtering, and video smoothing may be implemented by vendors to improve quality, but they are outside the ITU recommendations.

Macroblocks carry a flag to indicate whether they are predicted or intraframe macroblocks and a second flag to indicate whether the data should be transmitted or not. The criteria for choice of mode and for transmitting a block are not detailed by the recommendation and may be varied dynamically as part of the control strategy.

The standard requires H.261 devices to encode only the difference between a frame and the previous frame. Vendors can provide higher video quality and faster transmissions with optional motion-compensation and loop-filtering capabilities. Motion compensation analyzes macroblocks to identify a group in the previous frame that best matches a group in the current frame. The system then codes the difference along with a vector that describes the offset.

and Macintosh solutions for POTS connections, and the two are interoperable. VCC offers a proprietary Windows-based POTS product using one to four V.34 modems for high bandwidth. Intelligence at Large sells a Mac solution that works across both WANs (POTS and ISDN) and TCP/IP LANs. Complete kits cost approximately $2000; the standalone software costs $100 to $300.

LAN versions of Proshare, PictureTel's LiveLan, and competitors from Invision, Viewpoint, and Insoft, use proprietary audio- and video-coding algorithms. But LAN conferencing standards do not yet exist, and H.320 does not work in a packet-switched network. Cornell University's CU-SeeMe software for Windows and Macs works over TCP/IP networks, including the Internet. Sun, HP, and Silicon Graphics also provide LAN conferencing equipment.

C-Phone from Target Technologies and Minx from Datapoint move analog video over a dedicated network and often use vacant wires inside standard Ethernet cables. For WAN connections, a shared server provides the required H.320 codec functions. Uncompressed analog video offers superior quality and does not stifle LAN data traffic. However, the scheme is not compatible with Ethernet or Token Ring bridges, routers, or switches. These products cost $2000 to $2500 per desktop, not including the required dedicated server, switch, and hub.

Unlike JPEG and MPEG, which are resolution- and image-size independent, H.261 specifies two image sizes. Common interchange format (CIF) is 352 pixels by 288 pixels. Quarter CIF (QCIF) is 176 pixels by 144 pixels. Like MPEG, H.261 uses prediction and motion estimation to reduce temporal redundancy, but it takes a different approach. MPEG maintains picture quality with maximum compression; H.261 minimizes encoding and decoding delay while achieving a fixed data rate.

What does this mean to videoconferencing users? H.261 makes a trade-off between frame rate and picture quality. As the motion content of the images increases, the codec has to do more computations and usually has to give up on image quality to maintain frame rate (or vice versa).

For an H.261 subsystem to meet the peak range of the standard—30 frames per second with full-motion estimation and loop filtering—it must execute approximately 8 billion operations per second. Most of this is for the optional motion estimation. However, designers can reduce operations at the expense of picture quality. For example, by applying a motion-estimation algorithm, codec designers can bring the system requirements down to about 1.5 billion operations per second (and thus let users do their videoconferencing on less-expensive hardware). Designers could also limit the video to 15 fps, which is a limit that ISDN bandwidths may impose.

Dedicated H.261 processors have reduced the complexity, development cycle, and costs of videoconferencing systems while providing better quality. The newer devices, such as AT&T's AVP III, support not only H.261 but an enhanced version (called H.263) and MPEG on the same chip.

Motion Slickness

H.263, which is backward-compatible with H.261, offers improved picture quality by using a half-pixel new-motion estimation scheme rather than H.261's integer-estimation approach. The half-pixel technique is noticeably better at predicting changes to low-resolution images than H.261's motion-estimation technique is. Also, the Huffman coding table used in H.263 is optimized for low-bit-rate transmissions and provides superior imagery at 28.8 Kbps, the speed of high-end modems. The ITU is considering incorporating H.263 support into the H.320 standard.

H.263 allows (but does not require) implementation of predictive frames as well as the I (DCT-coded) frames in the codec. This is similar to MPEG's approach. While predictive frames stress the computational load and increase the frame delay, they also add quality to the video stream by raising the frame rate. These hooks give the standards room to grow. Developers can maintain compatibility and interoperability, while the quality of audio and video can improve with improvements in silicon price and gains in performance.

The rise of videoconferencing standards means vendors must find ways of differ-

FACE OFF

Desktop videoconferencing (DVC) users often refer to the 90/10 rule to describe DVC's value: Data sharing accounts for 90 percent of the information content, while talking-head video accounts for the remainder. But video drains about 90 percent of the price and bandwidth resources for DVC systems. Also, without video, data conferencing is POTS-friendly, another point in favor of cost consciousness.

Early collaborative software provided a static whiteboard visible to all conference participants. Data from documents and spreadsheets appeared on the whiteboard, and changes made during a session had to be reentered in the original application. Newer versions give collaborators a shared program window, and users can make changes within the program window via keyboard or mouse commands, even if only one system has the application installed.

Stand-alone data-sharing products today range in price from $50 to $200, depending on their feature set and support for multiple LANs and WANs. Titles include Farsite, from DataBeam, which is bundled with many voice-and-data modems, and TalkShow and Vis-a-Vis from FutureLabs. These compete against data-conferencing versions of full-blown videoconferencing applications.

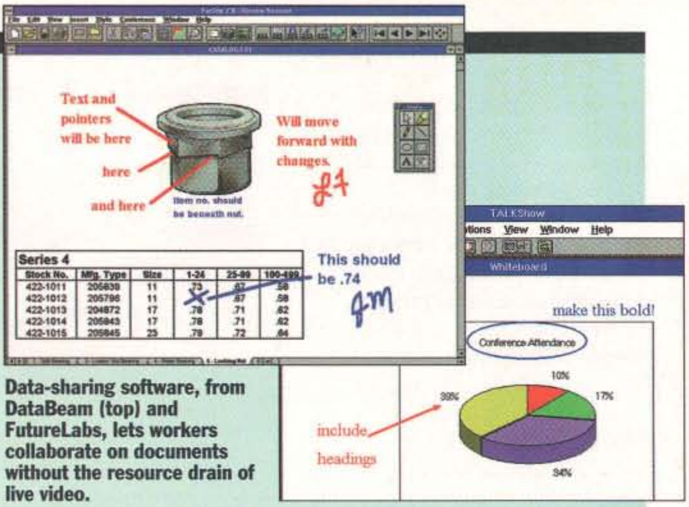
Proprietary R.I.P.

The collaborative computing market is in the throes of two transitions. Customers are demanding solutions that comply with standards. The T.120 standards, first promulgated by the International Multimedia Teleconferencing Consortium and now submitted to the ITU, have been endorsed by virtually all conferencing vendors. This essentially ends the future for proprietary products.

DataBeam, which markets stand-alone software, is licensing T.120 technology to its erstwhile competitors and has signed up AT&T, British Telecom, Microsoft, PictureTel, and VTel. IBM's Lakes architecture, middleware that allows multiple types of data streams to be serialized and synchronized across multiple hardware and software platforms, will also be compliant with T.120.

Equally important is the shift from data conferencing as a stand-alone application to an embedded OS technology. Future OSes will have an abstraction layer for real-time, multipoint, multimedia communications. Note Microsoft and PictureTel's plan to develop voice- and data-conferencing APIs for independent software vendors. The APIs will provide access to multipoint data communications capabilities based on T.120.

OS/2 already includes Person-to-Person software. The Mac OS uses the QuickTime Conferencing extension, a foundation used by Apple's Media Conference Application and by Crosswise's Face-to-Face software, a cross-platform document-conferencing solution.



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422-1014	205843	17	.78	.71	.62
422-1015	205845	25	.79	.72	.64

Data-sharing software, from DataBeam (top) and FutureLabs, lets workers collaborate on documents without the resource drain of live video.

entiating themselves without offering proprietary technologies. Opportunities to add value come not from designing proprietary codecs but from applying pre-filters and post-filters to the video stream to make the codec more efficient and raise the quality of the decoded picture. Vendors can also add echo cancellation and sound mixing to the audio streams, or they can create API-smart software.

Now that vendors don't have to fight interoperability battles, they can concentrate on price and performance. We're already seeing positive signs. Prices of H.320-compliant videoconferencing kits have fallen from $6000 to less than $2000 in the past two years, while audio and video quality have improved noticeably. These kits benefit from a new generation of low-cost codec chips with higher processing power and support for multiple audio- and video-compression algorithms. Some computer makers now sell systems that come with conferencing hardware, so users can buy configured systems and avoid installation hassles.

Visual Support

Standards and new chips may help DVC evolve into an essential tool for business. Some vendors envision videoconferencing as an embedded technology. Already, one manufacturer of printing presses is showing a videoconferencing component that links printshop workers with technical staff, so they can get help if the press goes down. When talking heads venture from the Future Pavilion of the World's Fair to the nuts-and-bolts world of a shop floor, videoconferencing will be ubiquitous. ■

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Circle 80 on Inquiry Card (RESELLERS: 81).

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Data Communications

OpenView ADVISOR

The Independent Newsletter for Openview Users and Developers

FEBRUARY 1995
VOLUME 1, NO. 1

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HP's Meta Schema: Blueprint for a Common Repository

By James Herman, vice president, Northeast Consulting Resources Inc.

COVER STORY

The term common reposito is sure e of most elusive in net management t day. Ev ent notion of what it mean should be designed. For examp repository should contain everythi event ever received by the managemen pository as essentially containing con Hewlett-Packard's partial Meta Schema bluep in Openview gives a first glimpse at HP's proposal fo solutio It also points to the vast amount of work left to be done before a working repository can become a reality.

Domains
Configuration Data
Topology
Notifications
Managed Object Data
Historical Trend Data
Denotes reference of one type of data on another
Types of mgmt. data currently discussed in the HP Meta Schema document

SOURCE: HEWLETT-PACKARD

To understand HP's initial attempt at defining an Openview common repository requires a closer look at the need it addresses. For the past several years, Openview has provided all the basic functions required of a management platform—management protocol support via SNMP, communications protocols, and application programming interfaces for developers. But the platform has lacked open services for the integration of management data from multiple applications. Under the covers, Openview applications don't share data. Instead, network inventory, event logs, trouble tickets, and other other sources of management data reside in separate files and system locations, many times in different formats.

For customers, this lack of integration results in having to maintain several management data files, a task that can quickly become a juggling act when it comes to keeping data files in sync. If the same data item appears in multiple locations, it must be updated repeatedly. Multiple data sources make report writing difficult and limit the scope of customization.

Openview's lack of data integration also has drawbacks for developers, who must invest significant R&D dollars in getting their applications to work with those of other vendors—for example, to tie maintenance trouble tickets to specific devices in the network inventory.

Moving to a common repository would provide users with the database functions required to enter data into the system just once and have it reflected across multiple applications. Report writing could be easily customized.

(Continued on page 16)

PREMIERES FEBRUARY 1995

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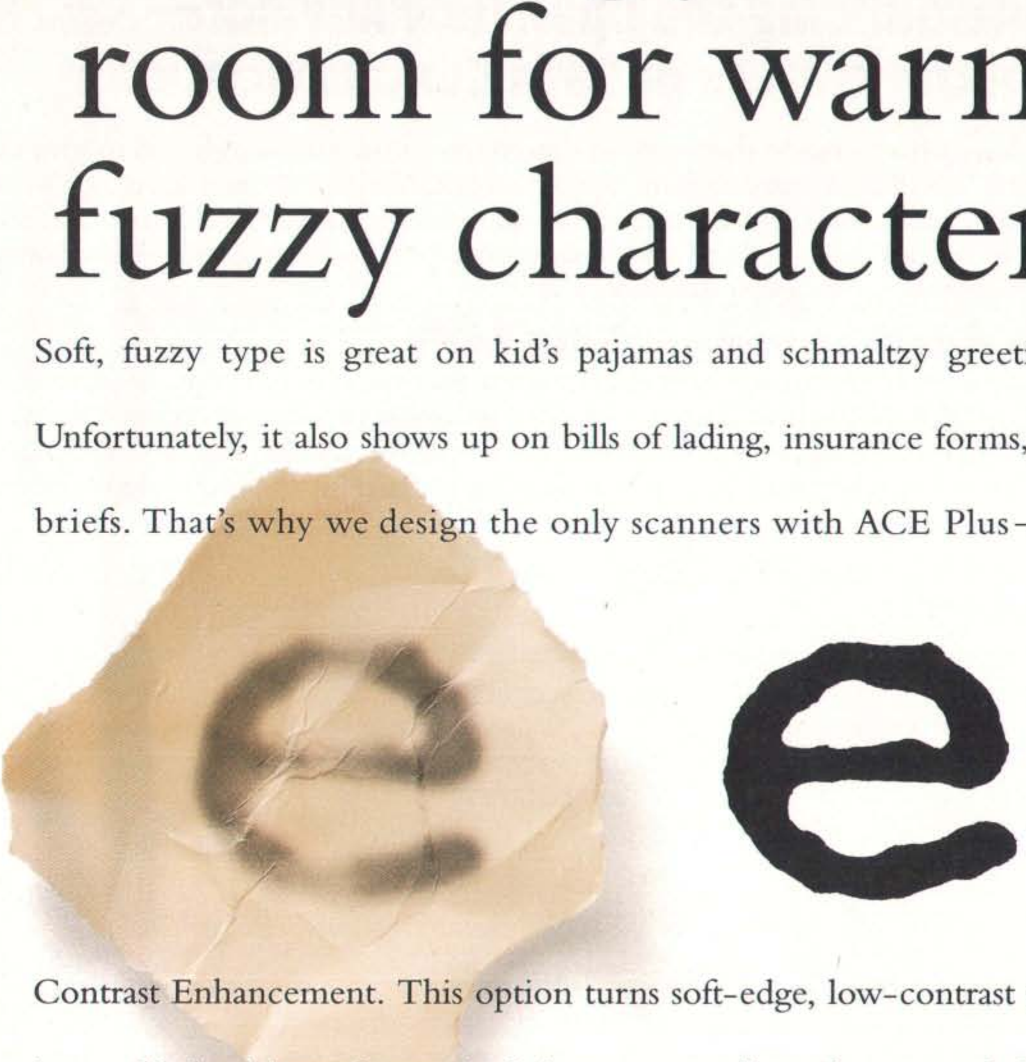

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Circle 64 on Inquiry Card (RESELLERS: 65).

Picking the Crypto Locks

PETER WAYNER

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How secure is your encrypted data? Advances in mathematics and increased computing power mean you need longer keys and stronger algorithms if you still want to keep your secrets. Both private-key encryption (which uses a single key for coding and decoding) and public-key systems (which use separate keys for encryption and decryption) are increasingly vulnerable to determined attack. But do these weaknesses represent a real threat to encrypted data, or are they still just intriguing research results?

Unfortunately, when we try to assess the effectiveness of today's popular cryptographic systems, we run into a problem of mathematical ignorance. Most people who are familiar with mathematics can work in two directions, forward and backward, like the simple algebraic equation $a = b + 1$. We can determine the value of the first variable from that of the second and vice versa. Crypto systems, however, generally rely on mathematics that works only in one direction. People assume these systems are secure because no one has yet shown how to work the mathematics backward and break open the message. In general, we determine the strength of most cryptographic systems by seeing how well they avoid the attacks we know have been used on other systems. If none of the past attacks seems to work, then we deem a system secure. For now.

A new technique called differential cryptanalysis can break even DES quickly

Let's look at how today's codebreakers work, the resources and time they need, and what we require in the way of new systems and longer keys. Recent assessments of the strength of private-key crypto systems involve looking for theoretical holes and measuring the time needed for a brute-force attack. Finding the holes can be devilishly hard, calling for deep mathematical insights. Brute-force attacks are easier to mount if enough computational hardware is available, but they're also easy to defend against.

The most important development in the realm of data encryption in recent years is Eli Biham and Adi Shamir's *differential cryptanalysis*. They showed how to mount a limited attack on today's most widely used cryptosystem, DES (the federal Data Encryption Standard), which is also the basis for Unix's password system.

Imagine that you had access to your victim's DES cipher "box" (the common term for an enciphering system) with preloaded keys. Your goal is to determine the 56-bit key, so that you can decrypt the other messages your victim had encrypted with the box. Biham and Shamir showed that you could infer the hidden key if you could pass 2^{47} messages through the box and observe what came out. This *chosen plaintext attack* builds up a statistical model of the cipher, and it needs this many plaintexts to produce an answer with confidence.

Most intriguing, this work exposed flaws in many DES substitutes. Because the U.S. government classified the details behind DES's design, many assumed that there might be a trapdoor through which the government could eavesdrop. To circumvent these potential trapdoors, some folks designed their own variations of DES. Most of these new ciphers, however, fall even faster to Biham and Shamir's mathematical machinery. FEAL-4, a faster replacement, for example, takes only four well-chosen plaintexts.

continued on page 80

Factoring in Public-Key's Future

Long thought nearly unbreakable, public-key cryptography is yielding to attack. The secret of security here is key length.

BY BRUCE SCHNEIER

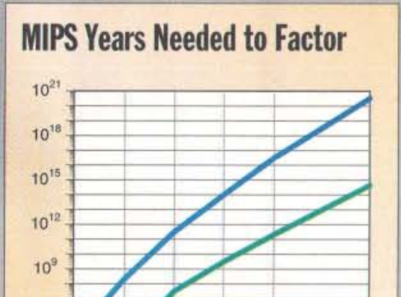
Factoring large numbers is hard but not as hard as it used to be. This has grave implications for the effectiveness of public-key cryptography, which relies on the difficulty of factoring long keys for its security. But how long is long enough?

In 1976, Richard Guy wrote: "I shall be surprised if anyone regularly factors numbers of size 10^{80} without special form during the present century." In 1977, Ron Rivest said that factoring a 125-digit number would take 40 quadrillion years. In 1994, a 129-digit number was factored. The lesson here is that making predictions is foolish.

Today, 512-bit keys are common. Factoring them, thus destroying their security, is well within the range of possibility for today's computing resources. A weekend-long worm on the Internet could do it.

Computing power is measured in MIPS-years: a million-instructions-per-second computer running for one year, or about 3×10^{13} instructions. A 100-MHz Pentium is about a 50-MIPS machine; a 1600-node Intel Paragon is about 50,000 MIPS.

In 1983, a Cray X-MP supercomputer factored a 71-digit number in 0.1 MIPS-years, using 9.5 CPU hours. That's expensive. Factoring the 129-digit number in 1994 required 5000 MIPS-years and used the idle time on 1600 computers around the world over an eight-month period. Although it took longer, it was essentially free.


MIPS Years Needed to Factor

Those two computations used what's called the *quadratic sieve*, but a newer, more powerful algorithm has arrived. The *general number field sieve* is faster than the quadratic sieve for numbers well below 116 digits and can factor a 512-bit number over 10 times faster—it would take less than a year to run on an 1800-node Intel Paragon.

And the process gets still faster. Mathematicians keep coming up with new tricks, new optimizations, and new techniques. A related algorithm, the *special number field sieve*, can already factor numbers of a specialized form (not generally used for cryptography) much faster. So we can probably optimize the general number field sieve to run that fast. For all we know, the National Security Agency is already doing it.

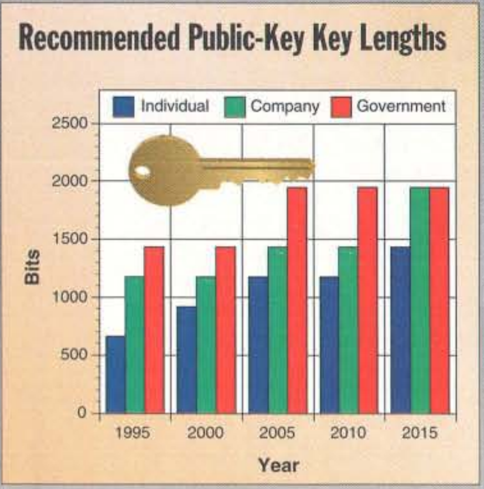
The figure "MIPS Years Needed to Factor" gives the number of MIPS-years required to factor "special" and "general" numbers of different lengths.

How Big Is Big Enough?

The wise cryptographer is ultraconservative when choosing key lengths for a public-key system. You must consider the intended security, the key's expected lifetime, and the current state of the factoring art. Now you need a 1024-bit number to get the same security you got from a 512-bit number in the early 1980s. If you want your keys to remain secure for 20 years, 1024 bits is probably too short.

Consider these assumptions from the mathematicians who factored RSA-129: We believe we could acquire 100,000 machines without superhuman or unethical efforts and without an Internet worm or virus. Many organizations have several thousand machines on the Net. Using their facilities would require diplomacy but should not be impossible. Assuming an average power of 5 MIPS and one year elapsed time, we could reasonably embark on a project that would require half a million MIPS-years. The project to factor the 129-digit number harnessed an estimated 0.03 percent of the Internet's total computing power. A well-publicized project might be able to harness 2 percent of the world's computing power for a year.

My recommendations for public-key lengths are given in the figure "Recommended Public-Key Key Lengths" according to how long you require the key to be secure. There are three key lengths given for each period—one secure against an individual cryptanalyst who can get his hands on 10,000 MIPS-years, one against a major corporation that could harness 10^7 MIPS-years, and the third secure against a major government and 10^9 MIPS-years. These figures assume that computing power will increase by a factor of 10 every five years and that mathematical advances will let us factor numbers at the speeds of the special number field sieve.


Recommended Public-Key Key Lengths

Not everyone will agree with these final recommendations. The National Institute of Standards and Technology has mandated 512- to 1024-bit keys for its Digital Signature Standard. PGP has a maximum RSA key length of 1280 bits. Arjen Lenstra, the world's most successful factorer, refuses to predict beyond 10 years. There's always the possibility that an advance in factoring will surprise me as well, though I tried to factor everything into my calculations. But why trust me? I just proved my own foolishness by making predictions. ■

Bruce Schneier is the author of Applied Cryptography *(John Wiley), the second edition of which is due out in December. He can be reached on the Internet as schneier@winternet.com, or on BIX c/o editors@bix.com.*

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STRENGTHS AND WEAKNESSES OF CRYPTO ALGORITHMS

ALGORITHM	COMMENT	STRENGTHS	WEAKNESSES
DES	Standard, widely accepted	Long-tested	Has yielded to DC
FEAL-4	DES substitute		Easily broken by DC
GDES, NewDES	DES-like		Easily broken by DC
Khufu	DES-like	Secure against DC	New, unknown
Blowfish	DES-like	Secure against DC	New, unknown
RC-4	Proprietary	Variable-length key	Unknown
RSA Public Key	Widely used	Long-tested	Vulnerable to advances in factoring
Skipjack	Classified	Considered strong	Algorithm must remain secret to preserve law-enforcement trapdoor

DC = differential cryptanalysis

Recently, the IBM scientists who originally designed DES revealed that they anticipated Biham and Shamir's attack and optimized DES to resist it. Because other nongovernment cryptographers didn't know about this attack, they couldn't design their software to resist it. Now the information is public, and there are new ciphers that hold up well against these attacks. Ralph Merkle's Khufu and Bruce Schneier's Blowfish are two private-key ciphers that are similar to DES but resist differential cryptography. They do this by creating new S-boxes for each encryption, using the key to randomize them. (S-boxes are the essential scrambling elements of DES-like ciphers. Think of them as lookup tables or nonlinear functions; their outputs should be as random as possible.) Differential cryptanalysis works only if the attacker knows what's in the S-boxes.

This work also revealed some stunning counterintuitive results. Key length is usually taken as a rough measure of a system's security. DES uses 56-bit keys; a brute-force attacker might need to try all 2^{56} keys to find the right one. A longer key would mean a longer brute-force attack. However, Biham and Shamir showed that even if DES used longer keys, it would hardly be any stronger against differential cryptanalysis. The statistical model would still be solvable if DES used the maximum of 768 bits.

Applying this knowledge to other types of ciphers is tricky. RSA Data Security markets a proprietary algorithm called RC-4 that accepts a variable-length key; this algorithm is used in many products. The flexible key length can be an advantage in some situations. For example, the government allows general export of software using RC-4 with a 40-bit key, but similar software using a longer key must stay within the U.S. While we don't know if differential cryptanalysis can be applied to RC-4 directly, because of the algorithm's proprietary nature, the results with DES suggest that more key is not necessarily stronger.

Men and Machines

Mathematical tools like differential cryptanalysis can be the most powerful attack against a cipher system. Brute-force attacks are normally a last resort, rare in practice because cipher designers routinely use long key lengths specifically to preclude them. But times are changing. We're reaching a point at which a large machine can quickly search the entire keyspace of DES. DES is still in wide use; it's been the commercial and governmental standard for nearly two decades. Replacing such standards can be a painfully slow process.

DES users should be thinking about what can be done with off-the-shelf hardware.

Brute-force attacks simply use large machines that try all possible passwords in parallel. It's even possible to produce native chips that run DES. Michael Wiener of Bell Northern Research described how to build a $1 million machine using a pipelined DES processor that could cruise through all possible keys in about 7 hours.

Massively parallel machines can also attack the problem. Some of the most promising emerging machines distribute small, 1-bit processors directly onto the memory chips. Some have 1024 processors on a chip with 42 bits of memory per processor. (Before it entered Chapter 11, Cray Computer was building for the National Security Agency a special Cray 3 with such processor-embedded memory.) In 1992 I designed a machine using 1 million associative processor memory chips (standard DRAM densities) from Coherent Research (Syracuse, NY) that could attack all of DES in one day. This machine could be reprogrammed to attack other DES-like ciphers. Linden Technology (Austin, TX) is currently exploring manufacturing new 4-Mb DRAMs with the 1024 associative processors built onto the chip.

Where to Find

RC-4
RSA Data Security, Inc.
Redwood City, CA 94065
(415) 595-8782
fax: (415) 595-1783
Circle 1060 on Inquiry Card.

The effect of brute-force attacks on DES is also important for Unix security, which stores each password after passing it through DES 25 times. At log-in, you type your password; it's encrypted 25 times and the result compared against the password file. If it matches, the system grants you access. Because the password file doesn't contain the passwords themselves, unauthorized users can't use the file to recover them directly. They must use a brute-force machine. However, the brute-force attack can be relatively successful against Unix, because the keyspace is smaller. Most users limit their passwords to alphabetic characters, occasionally adding numbers. This makes searching for passwords much faster; it could be done quite quickly with an associative-memory parallel processor. One estimate suggests that a computer using 512 of Linden's chips could test all six-character alphanumeric passwords in 15 minutes. Clearly, the Unix password structure needs to be rethought in light of today's machines and code-breaking techniques.

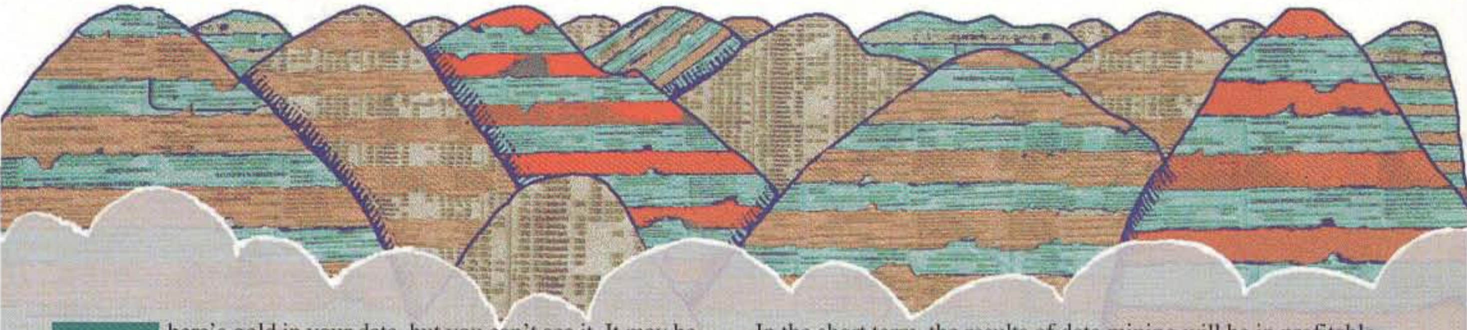
Because of this new vulnerability, you may want to explore other, newer ciphers, such as Merkle's Khufu or Schneier's Blowfish. The classified Skipjack algorithm buried inside the U.S. government's Clipper and Capstone encryption chips also uses S-boxes, but little is known about their design. There's little reliable public information about RSA Data Security's RC-4. Anyone who uses these algorithms must be prepared to trust the wits of the designers, because the algorithms have not undergone the intensely thorough and long-time public scrutiny given to DES.

Many organizations have opted to continue with DES, but the current state of the art is triple-DES—three passes of the algorithm with either 112- or 168-bit keys. This effectively guards against both brute-force and differential analysis attacks. These users can rest assured that, paradoxically, all the attacks focused on DES continues to keep it strong. ■

Peter Wayner is a BYTE consulting editor living in Baltimore, MD. You can reach him on the Internet at pcw@access.digex.net, on BIX as pwayner@bix.com, or on the World Wide Web at http://access.digex.net/~pcw/pcwpage.html.

DATA MINING

Turn computers loose on your data, and you don't know *what* they'll come up with—that's the whole point



There's gold in your data, but you can't see it. It may be as simple (and wealth-producing) as the realization that baby-food buyers are probably also diaper purchasers. It may be as profound as a new law of nature. But no human who's looked at your data has seen this hidden gold. How can you find it?

Data mining lets the power of computers do the work of sifting through your vast data stores. Tireless and relentless searching can find the tiny nugget of gold in a mountain of data slag.

In "The Data Gold Rush," Sara Reese Hedberg shows the already wide variety of uses for the relatively young practice of data mining. From analyzing customer purchases to analyzing Supreme Court decisions, from discovering patterns in health care to discovering galaxies, data mining has an enormous breadth of applications. Large corporations are rushing to realize the potential payoffs of data mining, both in the data itself and in marketing their proprietary tools.

In "A Data Miner's Tools," Karen Watterson explains the three categories of software to perform data mining. Query-and-reporting tools, in vastly simplified and easier-to-use forms, require close human direction and data laid out in databases or other special formats. Multidimensional analysis (MDA) tools demand less human guidance but still need data in special forms. Intelligent agents are virtually autonomous, are capable of making their own observations and conclusions, and can handle data as free-form as paragraphs of text.

"Data Mining Dynamite" by Cheryl D. Krivda shows how to facilitate the data-mining process. Data is handled far faster after it has been cleansed of unnecessary fields and stored in more convenient forms. Housing data in data warehouses reduces the load on production mainframes and supports client/server analysis. Parallel computing speeds the search process with multiple simultaneous queries. And any activity handling this volume of data requires consideration of physical storage options.

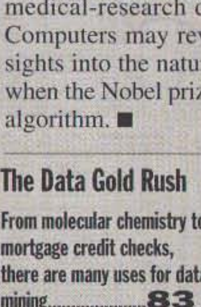
In the short term, the results of data mining will be in profitable if mundane business-related consequences. Micro-marketing campaigns will explore new niches. Advertising will target potential customers with new precision.

In the not-too-long term, data mining may become as common and easy to use as E-mail. We may direct our tools to find the best airfare to the Grand Canyon, root out a phone number for a long-lost classmate, or find the best prices on lawn mowers. The software will figure out where to look, how to evaluate what it finds, and when to quit. Our knowledge helpers may become as indispensable as the telephone.

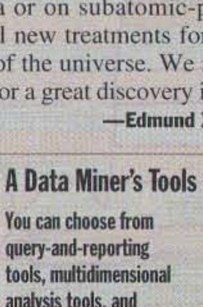
But it's the long-term prospects of data mining that are truly breathtaking. Imagine intelligent agents being turned loose on medical-research data or on subatomic-particle information. Computers may reveal new treatments for diseases or new insights into the nature of the universe. We may well see the day when the Nobel prize for a great discovery is awarded to a search algorithm. ■

—Edmund X. DeJesus, Senior Editor

The Data Gold Rush
From molecular chemistry to mortgage credit checks, there are many uses for data mining.................... 83



A Data Miner's Tools
You can choose from query-and-reporting tools, multidimensional analysis tools, and intelligent agents 91



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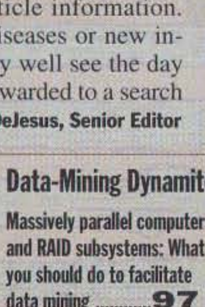

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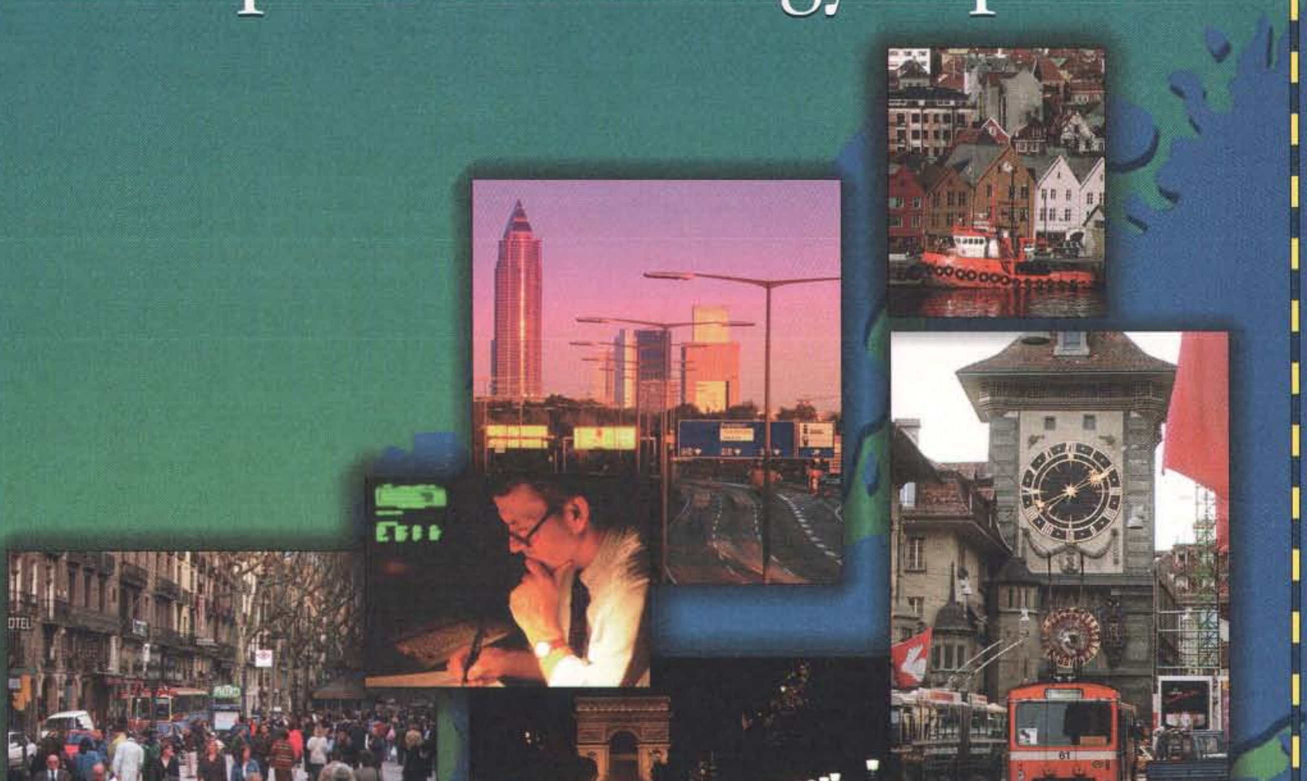

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THE DATA GOLD RUSH

Smart data miners are cashing in on valuable information buried in private and public data sources

SARA REESE HEDBERG

VICTOR GAD © 1995

It's in there. The discovery, the fact, the one piece of the puzzle that will blow away the competition, propel your company to the top, and stick a "VP" after your name. It's right there, in your database. But you can't see it. Yet.

The amount of information stored in databases is exploding. From zillions of point-of-sale transactions and credit card purchases to pixel-by-pixel images of galaxies, databases are now measured in gigabytes and terabytes. In today's fiercely competitive business environment, companies need to rapidly turn those terabytes of raw data into significant insights to guide their marketing, investment, and management strategies.

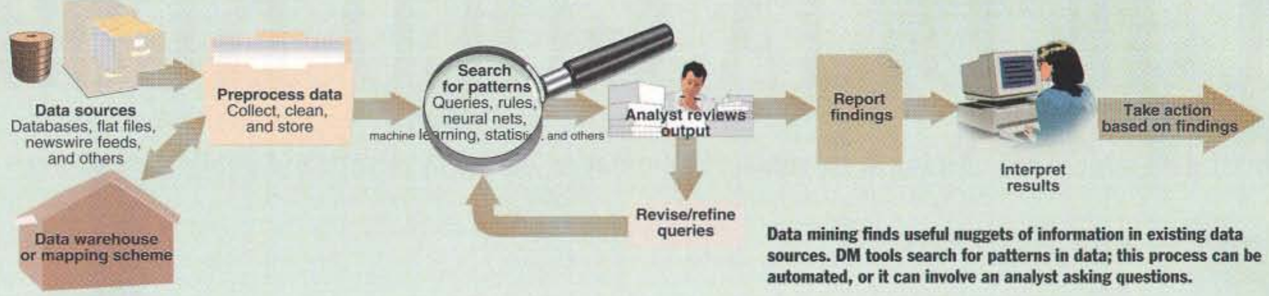
It would take many lifetimes for an analyst to pore over 2 million books—the equivalent of a terabyte—to glean important trends. But analysts have to. For instance, Wal-Mart, the chain of over 2000 retail stores, every day uploads 20 million point-of-sale transactions to an AT&T massively parallel system with 483 processors running a centralized database. At corporate headquarters, they want to know trends down to the last Q-Tip.

Luckily, computer techniques are now being developed to assist analysts in their work. Data mining (DM), or knowledge discovery, is the computer-assisted process of digging through and analyzing enormous sets of data and then extracting the *meaning* of the data nuggets. DM is being used both to describe past trends and to predict future trends.

Mining and Refining Data

Experts involved in significant DM efforts agree that the DM process must begin with the business problem. Since DM is really providing a platform or workbench for the analyst, understanding the job of the analyst logically comes first. Once the DM system developer understands the analyst's job, the next step is to understand those

Data-Mining Process


Data sources
Databases, flat files, newswire feeds, and others
Data warehouse or mapping scheme
Preprocess data
Collect, clean, and store
Search for patterns
Queries, rules, neural nets,
machine learning, statistics, and others
Analyst reviews output
Revise/refine queries
Report findings
Interpret results
Take action based on findings

Data mining finds useful nuggets of information in existing data sources. DM tools search for patterns in data; this process can be automated, or it can involve an analyst asking questions.

data sources that the analyst uses and the experience and knowledge the analyst brings to the evaluation.

The DM process generally starts with collecting and cleaning information, then storing it, typically in some type of data warehouse or datamart (see the figure "Data-Mining Process"). But in some of the more advanced DM work, such as that at AT&T Bell Labs, advanced knowledge-representation tools can logically describe the contents of databases themselves, then use this mapping as a meta-layer to the data. Data sources are typically flat files of point-of-sale transactions and databases of all flavors. There are experiments underway in mining other data sources, such as IBM's project in Paris to analyze text straight off the newswires.

DM tools search for patterns in data. This search can be performed automatically by the system (a bottom-up dredging of raw facts to discover connections) or interactively with the analyst asking questions (a top-down search to test hypotheses). A range of computer tools—such as neural networks, rule-based systems, case-based reasoning, machine learning, and statistical programs—either alone or in combination can be applied to a problem.

Typically with DM, the search process is iterative, so that as analysts review the output, they form a new set of questions to refine the search or elaborate on some aspect of the findings. Once the iterative search process is complete, the data-mining system generates report findings. It is then the job of humans to interpret the results of the mining process and to take action based on those findings.

AT&T, A.C. Nielsen, and American Express are among the growing ranks of companies implementing DM techniques for sales and marketing. These systems are crunching through terabytes of point-of-sale data to aid analysts in understanding consumer behavior and promotional strategies. Why? To increase profitability, of course.

Similarly, financial analysts are plowing through vast sets of financial records, data feeds, and other information sources in order to make investment decisions. Healthcare organizations are examining medical records in order to understand trends of the past; they hope this information can help reduce their costs in the future. Major corporations such as General Motors, GTE, Lockheed, Microsoft, and IBM all have R&D groups working on proprietary advanced DM techniques and applications.

MARKETING

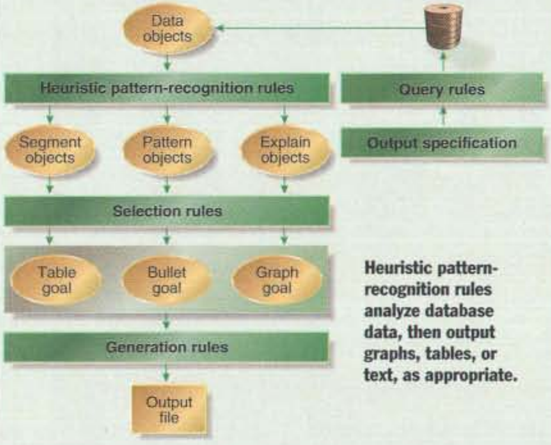
Many marketers believe one of the most powerful competitive weapons is understanding and targeting each customer's individual needs. To this end, more companies are harnessing DM techniques to shed light on customer preferences and buying patterns. With this information, companies can better target customers with products and promotional offerings.

A.C. Nielsen's Spotlight is a good example of a DM tool. Nielsen clients use Spotlight to mine point-of-sale databases. These terabyte-size databases contain facts (e.g., quantities sold, dates of sale, prices) about thousands of products, tracked across hundreds of geographic areas for at least 125 weeks. Spotlight transforms tasks that would take a human from weeks to months to do into tasks a computer can do in minutes to hours. Nielsen says it has sold about 100 copies of Spotlight (DOS and Windows) to U.S. clients, who have in turn deployed it to field-sales representatives in multiple regional centers. The software frees analysts to work on higher-level projects instead of being swamped by routine, laborious chores.

In the past two years, a global group at Nielsen has changed the U.S. version of Spotlight for use in other countries. "Spotlight is the most widely distributed application in the consumer packaged-goods industry," claims Mark Ahrens, director of custom software sales at Nielsen.

American Express is analyzing the shopping patterns of its card holders and using the information to offer targeted promotions.

Expert System Module



Heuristic pattern-recognition rules analyze database data, then output graphs, tables, or text, as appropriate.

Siftware

Hardware and software vendors are extolling the DM capabilities of their prod-

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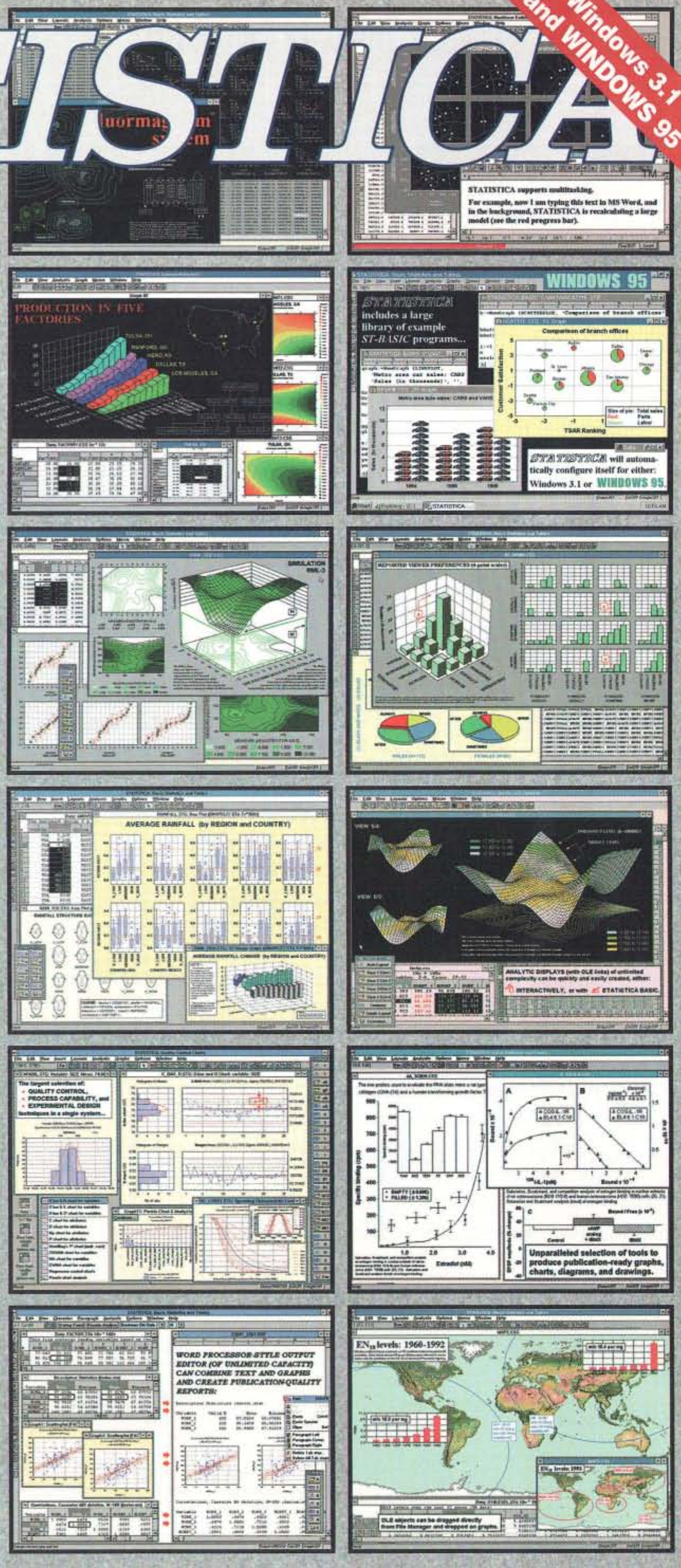

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ucts—whether they have true DM capabilities or not. This hype cloud is creating much confusion about data mining. In reality, data mining is the process of sifting through vast amounts of information in order to extract meaning and discover new knowledge.

It sounds simple, but the task of data mining has quickly overwhelmed traditional query-and-report methods of data analysis, creating the need for new tools to analyze databases and data warehouses intelligently. The products now offered for DM range from on-line analytical processing (OLAP) tools, such as Essbase (Arbor Software) and DSS Agent (MicroStrategy), to DM tools that include some AI techniques, such as IDIS (Information DIscovery System, from IntelligenceWare) and the Database Mining Workstation (HNC Software), to the new vertically targeted advanced DM tools, such as those from AT&T Global Information Solutions. (See "A Data Miner's Tools" on page 91 for more information on DM products.)

Many people argue that the OLAP tools are not "true" mining tools; they're fancy query tools, they say. Since these programs perform sophisticated data access and analysis by rolling up numbers along multiple dimensions, some analysts still include them in the category of top-down mining tools. The market has yet to see much in the way of more-advanced mining tools, although the spigot is being turned on by application-specific DM tools from AT&T, Lockheed, and GTE.

Let's Get Vertical

One major DM trend is the move toward powerful application-specific mining tools. "There is a trade-off in the generality of data-mining tools and ease of use," observes Gregory Piatetsky-Shapiro, principal investigator of the Knowledge Discovery in Databases Project at GTE Laboratories. "General tools are good for those who know how to use them, but they really require lots of knowledge to use them."

AT&T, for example, recently introduced Sales & Marketing Solution Packs to mine data warehouses. They're tailored to vertical markets in retail, financial, communications, consumer-goods manufacturing, transportation, and government. These programs provide about 70 percent of the solution, with final tailoring required to

GOVERNMENT

The U.S. Internal Revenue Service has developed a system to detect fraud and improve tax collections. The prototype system runs on PCs and includes KnowledgeSeeker (Angoss Software), ModelWare (TeraNet), and AIM (AbTech).

Beverly Cook, a researcher at the University of Wisconsin-Milwaukee, used IDIS to evaluate the death penalty–related votes and opinions of Supreme Court Justice Byron White. She found that his behavior was related to his affiliation with the conservative bloc of the Court and that his voting patterns were linked to the race of the accused.

HEALTH CARE

GTE Laboratories has built an advanced DM system to evaluate health-care utilization costs for GTE's employees and dependents. Health-KEFIR (KEy FIndings Reporter) pinpoints groups whose costs are likely to increase in the coming year, finding areas where specific intervention strategies are likely to save the most money. The system can slice and dice the data in thousands of different ways—by business units, age groups, or types of care, for instance. It can consider multidimensional factors for each subcategory of data, such as payments per day per hospital stay within various segments. (See the figure "The KEFIR System.")

Health-KEFIR selects only those medical conditions that are "interesting"; in other words, those for which there is a known procedure that improves health outcomes and decreases costs. An increase in normal pregnancies, for example, will not be flagged, while an increase in premature births will be flagged, since there are standard medical interventions in prenatal care taken to reduce the premature birth rate.

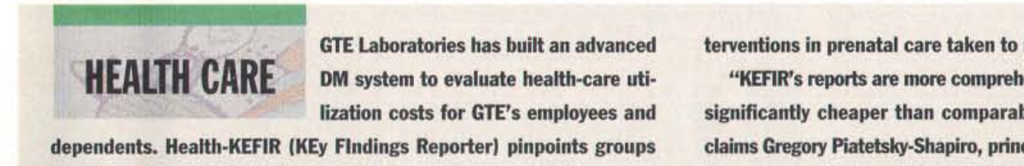
"KEFIR's reports are more comprehensive, generated in less time, and significantly cheaper than comparable medical consultant reports," claims Gregory Piatetsky-Shapiro, principal investigator of the Knowledge Discovery in Databases Project at GTE Laboratories.

KEFIR is written in tcl and C, with a SQL interface to ensure portability. It currently runs on a Sun SparcStation 20 workstation with Informix DBMS. Instead of a paper report of hundreds of pages, KEFIR's output is on the network in hypertext markup language (HTML) and GIF files, accessible by Web client software such as Netscape's Mosaic. Deployment to GTE regional managers across the country is scheduled for late 1995. GTE is now evaluating proposals to turn Health-KEFIR into a commercial product. It is also considering applying KEFIR to marketing and customer-analysis tasks.

Southern California Spinal Disorders Hospital in Los Angeles is using IDIS (IntelligenceWare) on PCs to discover subtle factors affecting success and failure in back surgery.

A coach in the U.S. Gymnastics Federation is using IDIS to discover long-term factors that contribute to an athlete's performance. This information will be used in order to treat potential problems early on.

The KEFIR System



KEFIR zeroes in on "interesting" health-care trends, then uses its findings to suggest cost-saving interventions.

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SCIENCE

DM techniques are starting to assist humans in scientific discovery. By traversing enormous data sets, they are finding patterns in molecular structures, genetic data, global climate changes, and more.

NASA-Jet Propulsion Laboratory and Caltech have developed SKICAT (SKy Image Cataloging and Analysis Tool), an advanced DM system to automatically analyze and catalog the second Palomar Sky Survey of the northern heavens. (SKICAT is written in C, runs under Unix, and employs custom algorithms and a Sybase DBMS.) When complete, the survey will catalog more than 50 million galaxies, about 2 billion stars, and 100,000 quasars. The survey will produce some 3 terabytes of data, which will be reduced to a galaxy catalog.

SKICAT recently discovered nine new quasars. With previous search techniques, it took three years to discover a similar number of the same type of quasars. With SKICAT, Caltech astronomers performed the same feat in less than six months using at least an order of magnitude less of observing time.

fit the individual client's needs, AT&T says. Complete with AT&T parallel hardware, software, and some services, Solution Packs start at around $250,000.

Both GTE and Lockheed Martin may shortly follow suit. GTE is already entertaining proposals to turn its Health-KEFIR (KEy FIndings Reporter) into a commercial product (see the "Health Care" text box on page 86). The Artificial Intelligence Research group at Lockheed Martin has been investigating and developing DM tools for the past 10 years. Recently, the Lockheed group built an internal application-development tool, called Recon, that generalizes their DM techniques, then applied it to application-specific problems. A beta version of the first vertical packages—for finance and marketing—will be available in 1996. The system has an open architecture, running on Unix platforms and massively parallel supercomputers. It interfaces with existing relational database management systems, financial databases, proprietary databases, data feeds, spreadsheets, and ASCII files.

In a similar vein, several neural network tools have been customized. Customer Insight Co., for instance, has built an interface to link its Analytix marketing software with HNC Software's neural network–based Database Mining Workstation, creating a marketing DM hybrid. HNC Software's Falcon detects credit-card fraud; according to HNC, the program is watching millions of charge accounts.

Invasion of the Data Snatchers

The need for DM tools is growing as fast as data stores swell. More-sophisticated DM products are beginning to appear that perform bottom-up as well as top-down mining. The day is probably not too far off when intelligent agent technology will be harnessed for the mining of vast public on-line sources, traversing the Internet, searching for information, and presenting it to the human user. Microelectronics and Computer Technology Corp. (MCC, Austin, TX) has been pioneering work in this area, developing a platform, called Carnot, for its consortium members. Carnot-based agents have been successfully applied to both top-down and bottom-up DM of distributed heterogeneous databases at Eastman Chemical.

"Data mining is evolving from answering questions about what has happened and why it happened," observes Mark Ahrens, director of custom software sales at A.C. Nielsen. "The next generation of DM is focusing on answering the question 'How can I fix it?' and making very specific recommendations. That's our focus now—our Holy Grail." Meanwhile, the gold rush is on. ■

FINANCE

Although there are reportedly a number of financial applications using DM techniques, the financial community is understandably tight-lipped about them. Numerous investment companies, for example, pick stocks with advanced DM systems, while some financial institutions have implemented systems designed for prevention and detection of fraud.

Security Pacific/Bank of America uses DM to help with commercial lending decisions and to prevent fraud.

Product Information

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Database Mining Workstation $51,000
(for software and PC board, processing, and training)
HNC Software
San Diego, CA
(619) 546-8877
fax: (619) 452-6524
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Falcon . . . . $250,000–$1 million
HNC Software
(see above)
Circle 1162 on Inquiry Card.

IDIS
PC. $1900
Server. . . . . depends on number of records to be processed (e.g., 1 million records, $25,000)
IntelligenceWare
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Prism . . . . $400,000–$1 million
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MINING OTHER DATA-MINING RESOURCES

Information about DM research, applica-tions, and tools can be found on the Knowledge Discovery Mine Website at http://info.gte. com/~kdd/.

Advances in Knowledge Discovery & Data Mining, U. Fayyad, et al., editors; AAAI/MIT Press, 1995.

Proceedings of the First International Conference on Knowledge Discovery and Data Mining, U. Fayyad, et al., editors; AAAI Press, 1995.

Sara Reese Hedberg is a freelance writer who lives in Issaquah, Washington. She has written extensively about emerging computer technologies. She can be reached at editors@bix.com.

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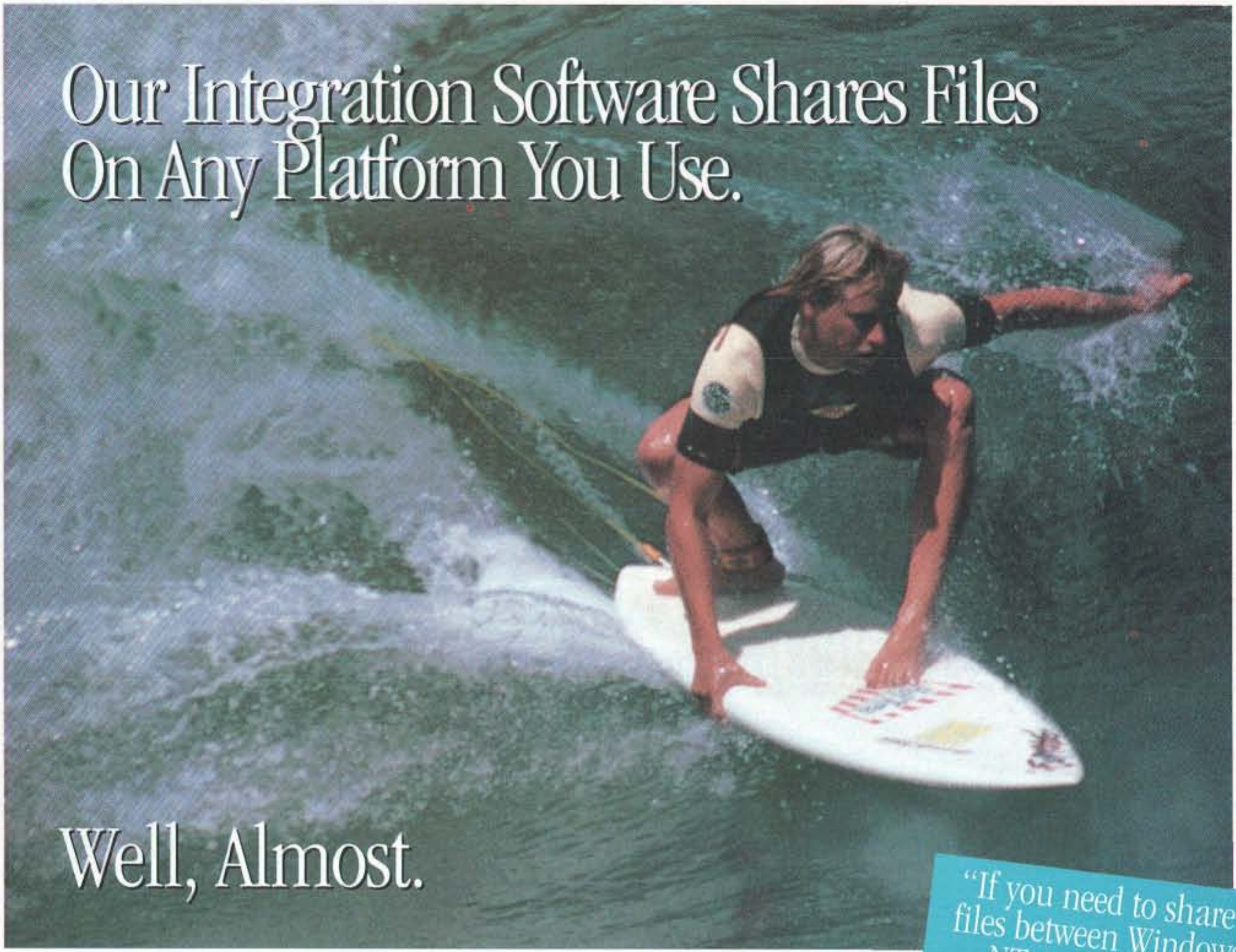
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A DATA MINER'S TOOLS

Intelligent agents, multidimensional analysis tools, and good old database queries all belong in the well-equipped data miner's toolbox

KAREN WATTERSON

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Put down that pickax, Eugene. Mining the information nuggets from your data requires specialized tools. Some are brand new, and some are borrowed from other sources; some are as dumb as bricks, and some seem to have minds of their own.

Even if your job description doesn't say anything about data mining (DM)—yet—the fact is that most information workers spend much of each day performing DM. The right tools can give your data miners that extra edge. As Don Keough, former president of Coca-Cola, might add to any discussion of DM, "Who[ever] has information fastest and uses it wins." So grab your helmet and check out what the well-equipped data miner is using.

Talk to My Agent

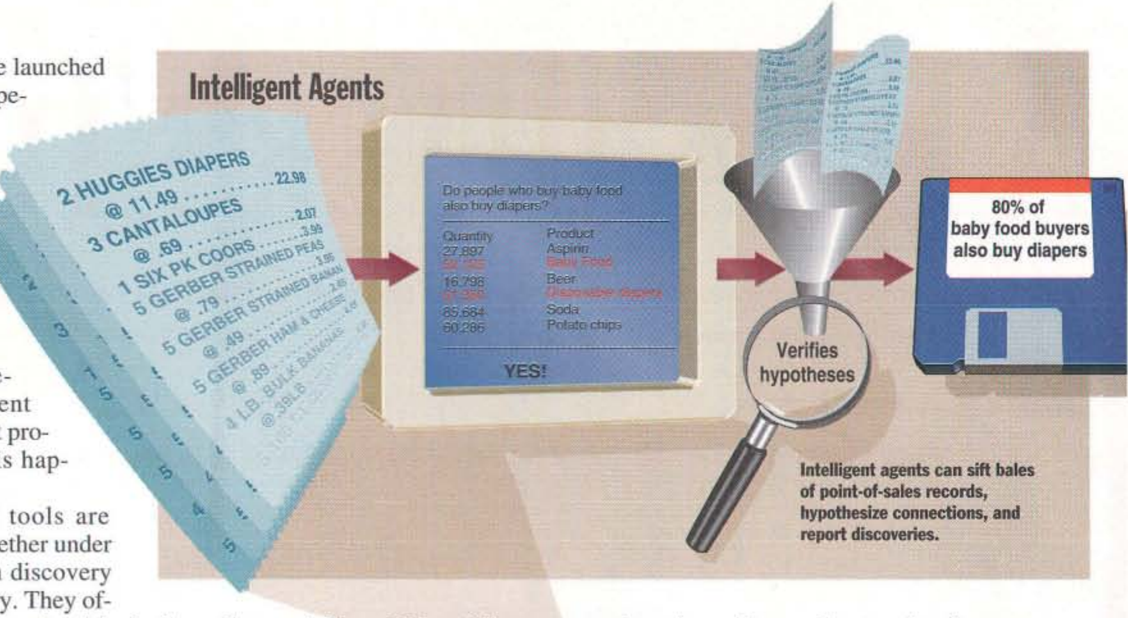
Remember Bill Gates's vision of "information at our fingertips"? Well, the truth is that most of us have information up to our eyeballs and probably receive more in a week than we could process in several lifetimes. One challenge of DM is to develop intelligent agents that can prioritize and/or filter the data bombarding us daily, including our overflowing E-mail. But DM is also about revealing new relationships and patterns and using software agents that will do the mining for us, often performing the screening and fetching functions of yesterday's secretaries and clerks.

The notion of harnessing computers to perform tedious chores is as old as science fiction. Have you ever tried to identify buying patterns of high-margin customers? Or look for patterns that may be indicators of fraud? Do you use an Internet clipping service to provide you with a personal news summary? Or alert you to wire-service announcements related to a key competitor? If the answer to any of these questions is yes, you're already dealing with the tasks of intelligent agents.

Several categories of intelligent agents are available. Some are launched manually to perform specific queries or to search for patterns in data. Others fire off automatically at predefined intervals, performing a task or monitoring a condition in the background and returning an alert as required. Most intelligent agents are simply short programs that say "if this happens, do that."

A handful of DM tools are sometimes lumped together under the rubric information discovery or knowledge discovery. They often have a resemblance—algorithmically speaking—to expert systems or AI. Most of these autonomous tools are low-touch but high-tech.

As Adam Szladow, president of Reduct Systems, a firm that markets rule-generating software, says, "One wants to get strong, repetitive patterns, patterns that occur with some frequency." One Reduct customer discovered rules for predicting business creditworthiness based on a database that had only a few hundred cases.



Intelligent Agents

Intelligent agents can sift bales of point-of-sales records, hypothesize connections, and report discoveries.

Mining for Dollars

For some people, intelligent agents are the sine qua non of DM. Barry Mason, who is a principal with IBM's Consulting Group, defines DM as "discovery tools which take large amounts of detailed transaction-level data and apply mathematical techniques against it, 'finding' or discovering insights into consumer behavior."

For Mason, DM is the first step in a series of activities that can lead to new actionable business intelligence. IBM has proprietary, patent-pending techniques to analyze gigantic data sets for cross-marketing or affinity marketing and look for patterns. These patterns may be so nonobvious as to appear almost nonsensical, such as that people who have bought scuba gear are good candidates for taking Australian vacations.

Other products, such as the DataEngine from MIT GmbH, use fuzzy logic and neural-network algorithms to do DM that helps analyze and control real-time technical processes. DataEngine, a programmer's tool not intended for casual end users, includes a visualization component that can provide hints about process bottlenecks, for example.

Reduct's Data/Logic products also ferret out patterns, automatically generating rules that can be probed using varying degrees of boundary "roughness," a technique akin to fuzzy set analysis. Wall Street analyst Murray Riggiero Jr. used Data/Logic in conjunction with neural-network software to generate rules for his trading system.

IntelligenceWare's automatic information-discovery tool, IDIS, also looks for correlations. It forms, tests, and modifies its own hypotheses until classification rules or rules with intervals, or more inexact rules, emerge. IDIS has been used successfully in applications ranging from fraud detection to consumer loan analysis to optimizing production lines.

Most humans are better at detecting anomalies than inferring relationships from large data sets, and that's why information discovery can be so useful. Rather than relying on a human to come up with hypotheses that can be confirmed or rejected based on the evidence (i.e., data), good discovery tools will look at the data and essentially generate the hypotheses.

Selecting Data-Mining Tools

Intelligent agents require some expertise to set up but need little direction. Some work directly on text. Best used for turning up unsuspected relationships. Don't turn these things loose on production systems, though.

Multidimensional-analysis (MDA) tools can have simple graphical interfaces for nonexpert use. Work on databases but really zip with multidimensional hypercubes of data (special setup). Best use: iterative, interactive, hands-on exploration of data.

Query-and-reporting tools require close direction to frame queries (many simplify the process with graphical interfaces). Require a database structure. Best use: asking specific questions to verify hypotheses. Legendary for their ability to bog down production systems.

A Dimension of Mine

Do you use your spreadsheet's crosstab or pivoting features? Have you explored data using slice-and-dice techniques to examine it from different perspectives and in varying amounts of detail? If so, you've encountered another part of the DM toolbox: multidimensional analysis (MDA), or online analytical processing (OLAP), tools.

Bruce Love of the Gartner Group has described DM as "an intensive search for new information and new combinations pursuing defined paths of inquiry and allowing unexpected results to generate new lines of analysis and further exploration." Love is clearly thinking of iterative exploratory techniques of data surfing using MDA or OLAP tools. MDA represents data as *n*-dimensional matrices called hypercubes. OLAP and related hypercubes

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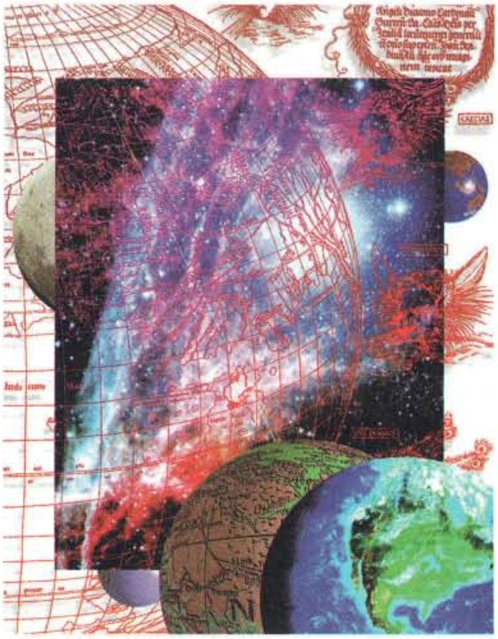

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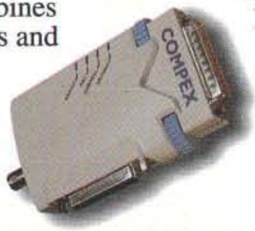

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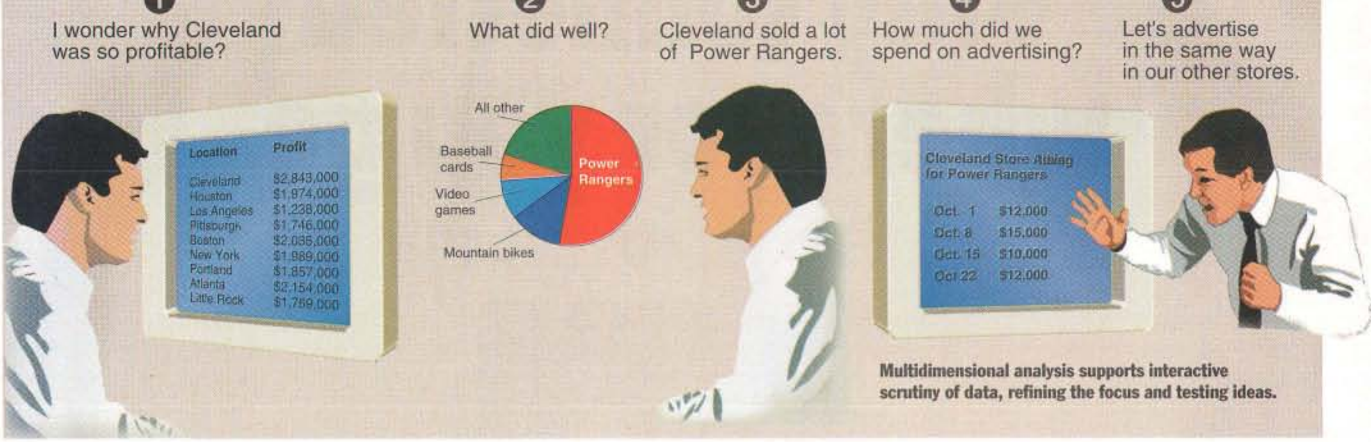
Multidimensional Analysis



Multidimensional analysis supports interactive scrutiny of data, refining the focus and testing ideas.

let users iteratively calculate metrics such as sales, revenue, market share, or inventory over a subset of available data, by exploring combinations of one or more dimensions of data.

The idea is to load a multidimensional server with data that is likely to be combined. Imagine all the possible ways of analyzing clothing sales: by brand name, size, color, location, advertising, and so on. If you fill a multidimensional hypercube with this data, viewing it from any 2-D perspective—*n*-dimensional hypercubes have $n*(n-1)$ sides, or views—will be easy and fast.

That's the appeal of products from vendors such as Arbor Software (Essbase), Comshare (Commander OLAP), Oracle/IRI Software (Express EIS), and Pilot Software (Lightship). Karl Stephan, a senior financial manager in Sears's planning analysis section, remembers when it took hours to assemble the data he needed into a spreadsheet. Using Essbase, it takes just seconds. Delta Airlines has used OLAP to gain insights into its frequent-flier program. Using Planning Sciences' Gentium, it's consolidated data from a 100-GB Teradata database into six far more accessible multidimensional databases totaling a mere 6 GB.

OLAP servers are great for time-series analyses, recursive calculations (e.g., how to allocate overhead as a percent of revenue contribution by product line), and data with up to about 15 dimensions. Beyond that, most multidimensional servers fail under the sheer weight of their own indexes. Michael Saylor, president of OLAP vendor MicroStrategy, segments the DM market into three parts. He recommends spreadsheets and query tools for slice-and-dice data mining on databases of up to about 1 GB, departmental OLAP servers for up to about 20 GB, and enterprise warehouses for anything above that.

George Zagelow, program manager for data-warehousing solutions at IBM, concurs that most businesses need more than a single DM tool. "Multidimensional databases, OLAP products, DM, and traditional decision-support tools all belong in your toolbox right alongside standard relational databases."

For example, rather than use an OLAP or hypercube tool, you're better off creating a warehouse using a relational database if you have lots of data or are facing complex loading and consolidation from multiple data sources. Why? Because there's a mature utility market to support those activities. However, don't expect mining operations that represent joins across many multirow tables to be fast. That's where OLAP servers shine, providing blindingly fast results to queries along predefined dimensions.

Hypercubes vs. Killer Queries

Let's say you decide to mine your existing database to find the customers most likely to respond to a mail-order promotion. You might try using a query-and-reporting tool such as Information Builders' Focus Reporter or Software AG's Esperant to construct the SQL query, "How many credit-card customers who made purchases of over $100 on sporting goods in August have at least $2000 of available credit?" If the number is too big, you might refine it: "Narrow it down to customers under 40 who live within 30 miles of a store in a coastal state."

Although you can construct queries such as these using query-and-reporting tools that work with relational databases, such unfettered querying can bring a production system to its knees. That's why DM operations are usually made against data that's been warehoused, either in a traditional relational database or consolidated into a multidimensional hypercube.

Although the relational/OLAP wars may continue for another year, chances are we'll see some convergence. Already, relational warehouses and virtual OLAP servers based on the relational model are adding support for star schemata. The idea is to mimic multidimensionality by creating special tables that contain roll-up data. For example, you might have a central fact table with sales data, surrounded by star tables with location, time, and product data. An innovation from Cross/Z International uses fractals to store warehouse data. The idea behind Fractal Database Mining System is to provide OLAP-style responses for huge data warehouses.

Because adding intelligent-agent capability to software isn't that complicated, most of today's OLAP products and query-and-reporting tools (e.g., Brio Technology's BrioQuery, Comshare's Commander OLAP with Detect and Alert, Information Advantage's NewsLine 3.0, and Trinzic's Forest & Trees) have this sort of intelligent agent built in. Comshare's Detect and Alert "robots" monitor news feeds or even Lotus Notes databases for keywords and stock quotes from Dow Jones News/Retrieval for predefined values.

With Forest & Trees, an administrator sets up alarms for trigger values. Many warehouse and middleware products (e.g., Trinzic's InfoPump) include intelligent agents that schedule data transfer from

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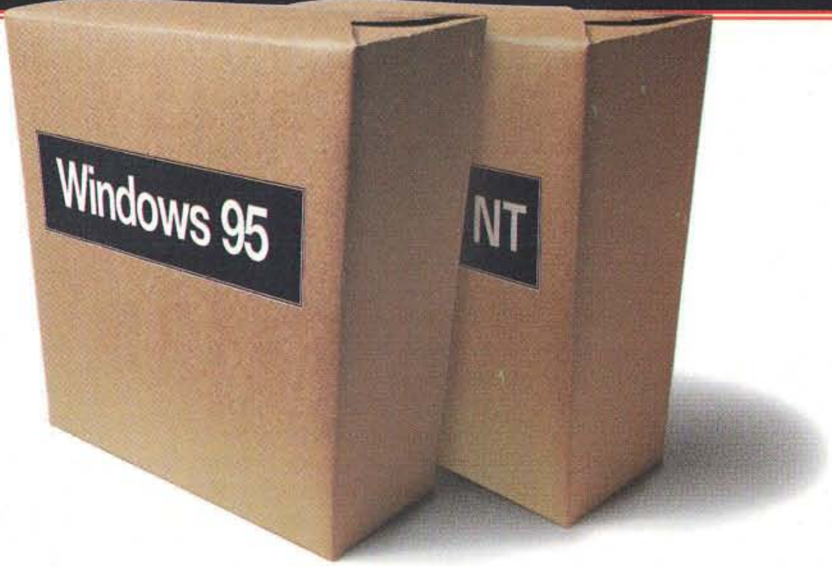

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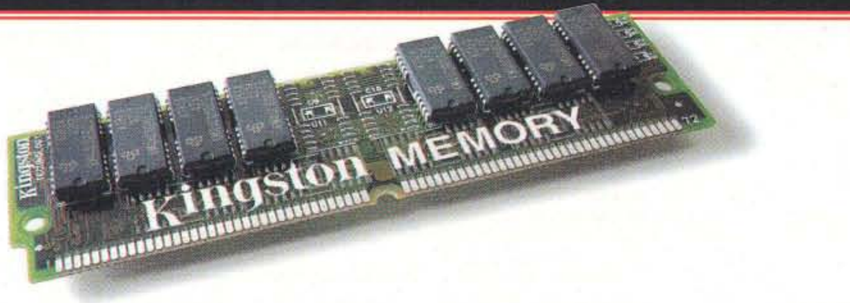

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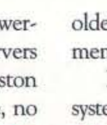

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production systems to decision-support databases.

Mining with Query Tools

If you don't have an OLAP server or an enterprise data warehouse, don't despair. Lots of mining can be done from the desktop using client/server generation query-and-reporting tools. With many products available (e.g., Business Objects, Powersoft's InfoMaker, and Crystal Service's Crystal Reports), it's hard to differentiate among them. They range from traditional spreadsheets to products from vendors such as IQ Software and Cognos that provide strong support for MIS oversight.

Most of these tools come with graphing components. Some even support a degree of multidimensionality, such as pivoting, intelligent drilling, crosstab reporting, and time-series analysis. A few are beginning to offer easy-to-use intelligent-agent support (versus alerts that can be established programmatically). If you need to select a new query-and-reporting tool and need to support a mixed environment of PCs and Macs, be sure to make that a feature on your checklist.

You should think of query-and-reporting tools as generic mining tools. They generally support direct access to source data and may offer cross-database joins, but their unbridled use can wreak havoc with production systems. And, given the challenges of performing joins across systems, it may be hard for end users to know if the answer they're getting is accurate.

Query tools can be used for interactive exploration, especially against relational data. Most query tools construct SQL queries for the data miner and can be slow if the source data is scattered among many tables—especially large ones, on multiple databases, that are poorly indexed.

Tooling Up

DM is such a hot concept that it's showing up in nonspecialized tools. For example, high-end financial and statistical analysis, decision-support, and EIS vendors are adding DM capability (or, at least, labeling) to their products. Also, enterprise database vendors such as IBM and Hewlett-Packard are creating data- warehouse suites (IBM's Visual Warehouse) or virtual-warehouse frameworks (HP's Open Warehouse) that include—you guessed it—DM tools.

Converging from the desktop are spreadsheets and query-and-reporting tools associated with client/server applications. These tend to be high-touch tools, although many let users set up hands-off intelligent-agent alerts.

IntelligenceWare's Kamran Parsaye views DM and decision support as a set of fairly distinct spaces, each with its own set of algorithms. This includes an aggregation space containing precomputed OLAP data (to answer such questions as "What is the trend in Joe's sales by product and by month compared with average sales figures?"), an influence or discovery space (where relationships are discovered and refined), and a related variation space (for questions such as "How have weekly changes in prices varied over the last year?").

Because information-discovery tools have only recently gained widespread attention as DM tools, they still tend to be rather technical and best suited for analysts with strong mathematical backgrounds. Look for explosive growth in this area of DM tools as better user interfaces make them easier for end users to harness. As for intelligent agents, especially agents as Internet gofers and E-mail filters, within a year, you'll wonder how you ever lived without them.

The popularity of DM shows that businesses are looking for new ways to let end users find the data they need to make decisions, serve customers, and gain a competitive advantage. If your workers aren't asking for better mining tools, you'd better ask why. ■

Karen Watterson is an independent San Diego–based writer and consultant specializing in client/server issues. She is the editor of two newsletters and the author of Visual Basic Database Programming *and* Client/Server Technology for Managers *(both from Addison-Wesley). You can reach her at 1119390@mcimail.com.*

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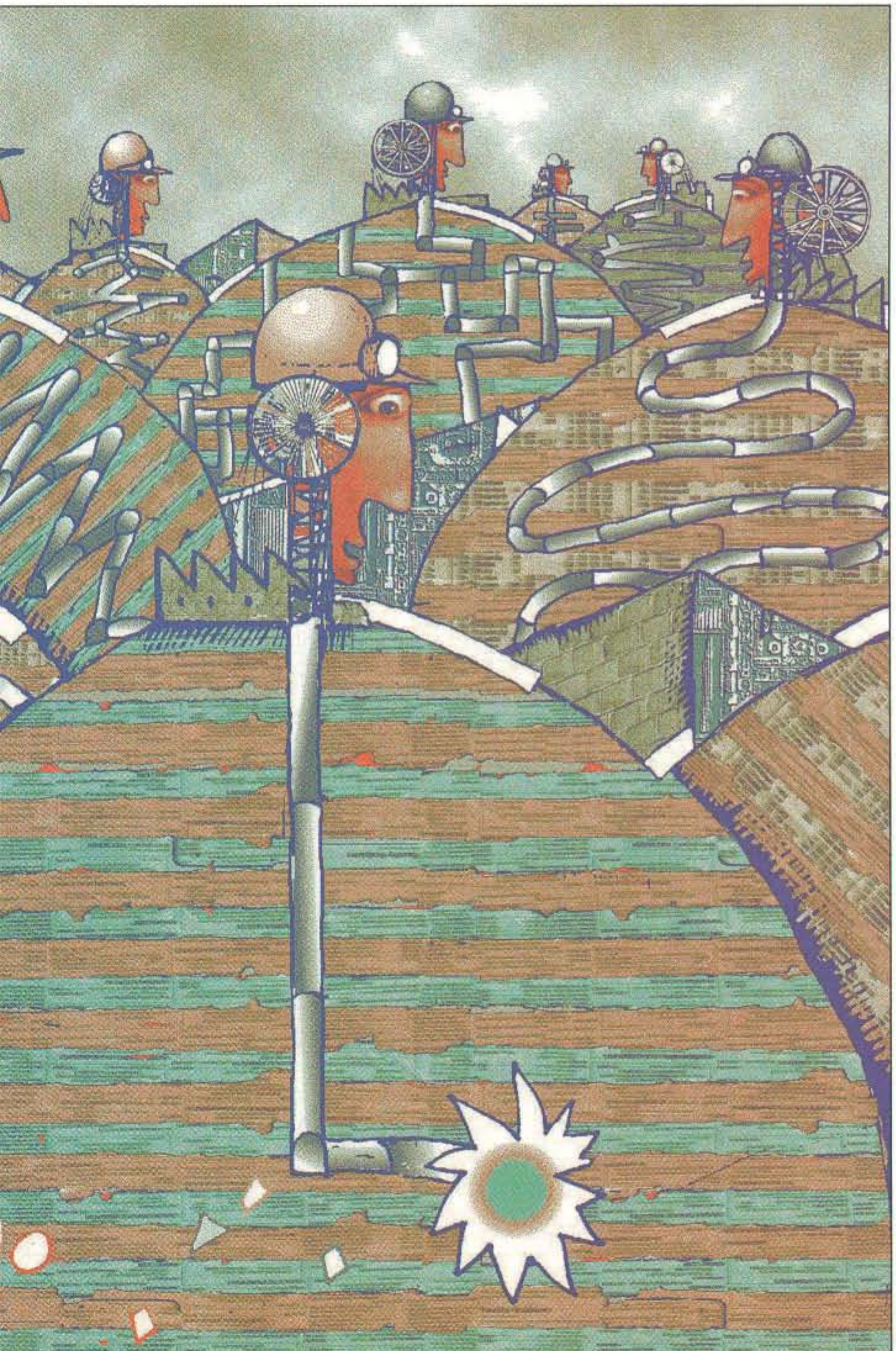
DATA-MINING DYNAMITE

Blasting loose those buried nuggets of information requires clean data, warehousing strategies, powerful parallel processors, and heaps of hard disk space

CHERYL D. KRIVDA



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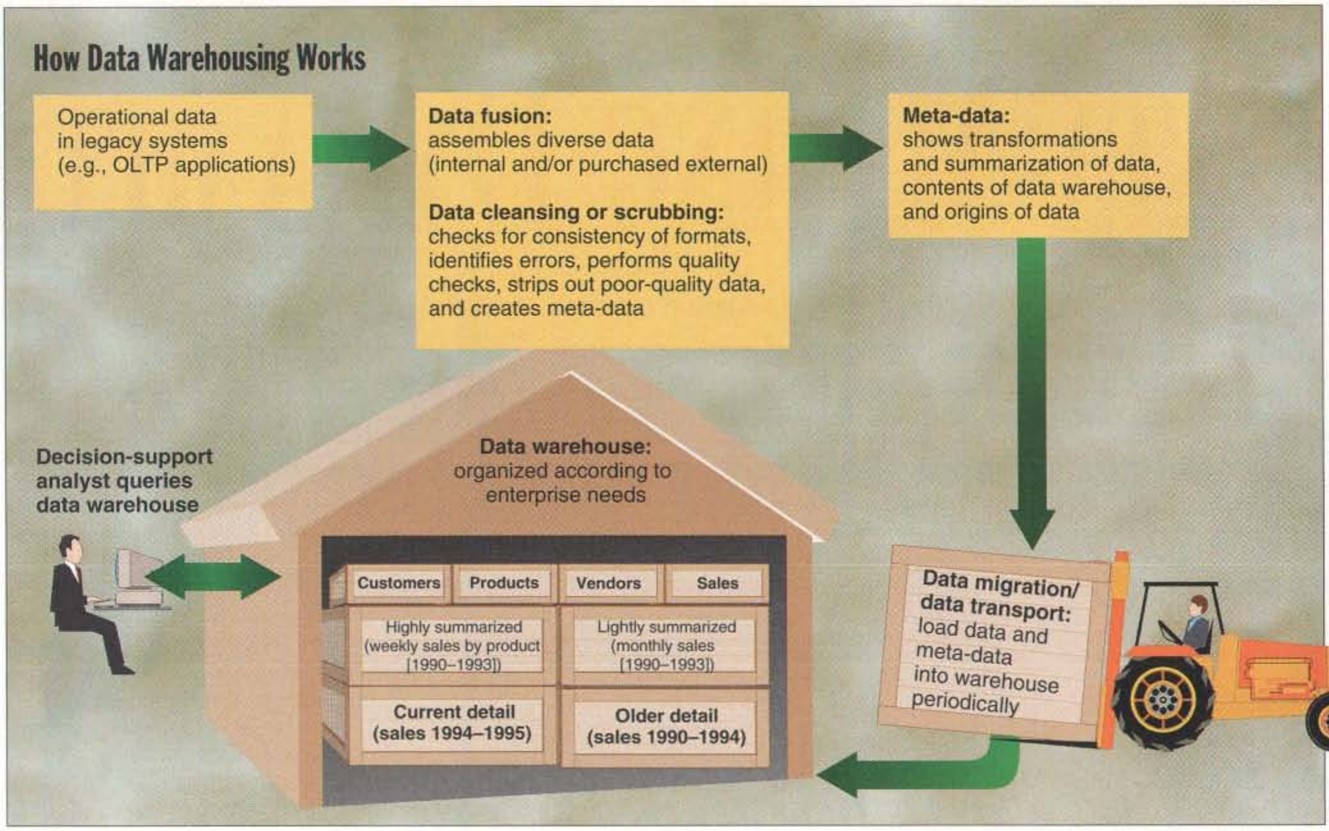
Nothing loosens up that pesky nugget like a well-placed stick of dynamite. Similarly, there are ways in which you can significantly speed up and simplify your data-mining activities. Data-cleansing and data-fusion tools can transform bales of operational data into error-free, consistently formatted information. Data warehouses support storage and access on specialized servers. Parallel-processing techniques accelerate data mining's complex queries. And, when you have terabytes of data to stash, storage considerations are important, especially as the price of disk space plummets.

Why bother? Remember: The whole point of data mining is to reveal hidden information for prompt decision-making and action. And there's also the matter of the 1000 percent return on investment that some data-mining pioneers are enjoying.

Clean and Scrubbed

While preparing to initiate some data mining, one New York City merchant bank discovered that its databases contained up to 13 different representations of some customer's names, such as Andrew B. Jones/ Mr. A. Jones. This is but one example of a common problem: Databases storing a company's lifeblood information about customers and transactions are commonly rife with errors, duplicate data (or worse), and information that would not necessarily be useful to data-mining applications. One bank has already saved $170,000 per month that it had been spending on duplicate mailings by cleaning up its customer data and then housing it with associated account information, according to Peter Kastner, an analyst with the Aberdeen Group, a Boston-based market-research and computer-industry consulting firm.

For data-mining applications to produce valid results, data has to be cleaned of errors and "scrubbed" to create consistent formats (e.g., 1s and 0s become male and



How Data Warehousing Works

Operational data in legacy systems (e.g., OLTP applications)
Data fusion: assembles diverse data (internal and/or purchased external)
Data cleansing or scrubbing: checks for consistency of formats, identifies errors, performs quality checks, strips out poor-quality data, and creates meta-data
Meta-data: shows transformations and summarization of data, contents of data warehouse, and origins of data
Decision-support analyst queries data warehouse
Data warehouse: organized according to enterprise needs
Customers
Products
Vendors
Sales
Highly summarized (weekly sales by product [1990–1993])
Lightly summarized (monthly sales [1990–1993])
Current detail (sales 1994–1995)
Older detail (sales 1990–1994)
Data migration/ data transport: load data and meta-data into warehouse periodically

female). The process can be a slow one. Although reasonably priced tools are available to reformat data, cleanse it, and prepare it for eventual migration to a data warehouse (explained later), information-systems (IS) management must also dedicate time to the effort of determining which format to use and how data should be represented before warehousing it.

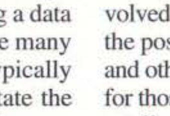
The payoffs can be dramatic. One telephone company was able to mine its cleaned and warehoused data to identify 10,000 supposedly "residential" customers who spent more than $1000 per month on their phone bills. Investigating more closely, the telephone company discovered that these customers were really small businesses trying to avoid paying business rates for their service.

A Place for Everything

The mainframe: A nice place to visit, but you wouldn't want to mine there. For one thing, production mainframes often support day-to-day business activities (e.g., airline reservations) that you probably do not want to impede with your killer queries. In addition, you probably want a well-behaved data server that you can hang your mining clients from. Besides, the data structures on your mainframe probably aren't the best for the data-mining activities you want to perform.

Enter the *data warehouse*, a server-based replication of a mainframe's data. The server receives updated information from the mainframe periodically—monthly, weekly, or even daily, depending on needs. The database on the data-warehouse server then fields data-mining queries from the client machines independently of the mainframe.

A data warehouse provides an effective structure for data mining, explains Bill Inmon, cofounder of Prism Solutions (Sunnyvale, CA) and widely considered the originator of the data-warehousing concept. Without first warehousing its data, a company has lots of information that is not integrated and has little summary information or history. The effectiveness of mining such data, he says, is limited.



Think data warehousing sounds easy? In actuality, the difficulty of getting a data warehouse operational is one of the many reasons why sites building them typically engage outside expertise to facilitate the project. Although consultants with experience in designing and populating data warehouses are few and far between, and expensive when available, they are typically worth the investment, especially for high-profile projects.

Still, convinced that data cleansing and warehousing sound like jobs that their best analyst will be able to handle, some companies elect to go it alone. "We see a lot of cheap science projects," says Chuck Buffum, general manager of the decision-support business unit for Tandem Computers (Cupertino, CA).

One Fortune 100 company IS manager waited three years for his staff to complete a high-profile data warehouse, relates Dr. Kamran Parsaye, CEO of Information Discovery (Hermosa Beach, CA). When poor warehouse design prevented the company from successfully populating the warehouse with clean data, the IS manager directed his staff to mine the production data and deep-six the warehouse plans. "It was success by declaration," Parsaye says.

1000 Percent Return on Investment

For all the warnings about the dangers involved in building a useful data warehouse, the possibilities for competitive advantage and other market gain seem equally endless for those who build one successfully. Some retail companies have achieved a payoff of 10 to 70 times their initial investment of $350,000 to $750,000, notes David Gelardie, manager of commercial markets for IBM's RS/6000 Division (Somers, NY). At the high-priced end of the hardware spectrum, one customer who invested $20 million in a complete system achieved a

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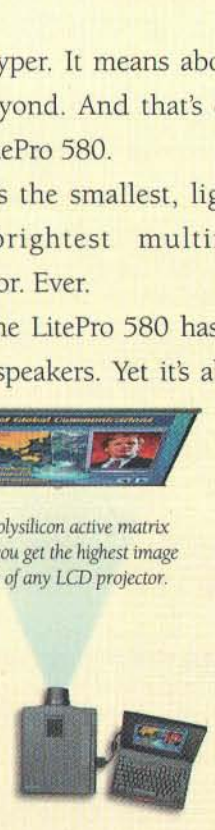

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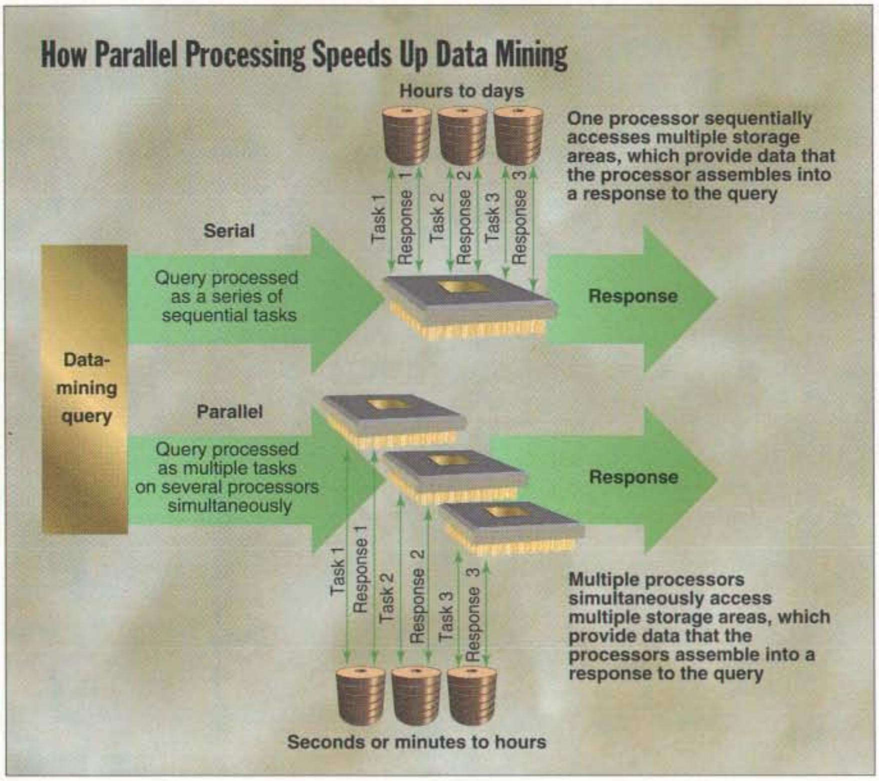


How Parallel Processing Speeds Up Data Mining

Hours to days
One processor sequentially accesses multiple storage areas, which provide data that the processor assembles into a response to the query
Task 1
Response 1
Task 2
Response 2
Task 3
Response 3
Serial
Query processed as a series of sequential tasks
Response
Data-mining query
Parallel
Query processed as multiple tasks on several processors simultaneously
Response
Task 1
Response 1
Task 2
Response 2
Task 3
Response 3
Multiple processors simultaneously access multiple storage areas, which provide data that the processors assemble into a response to the query
Seconds or minutes to hours

payoff in just four months.

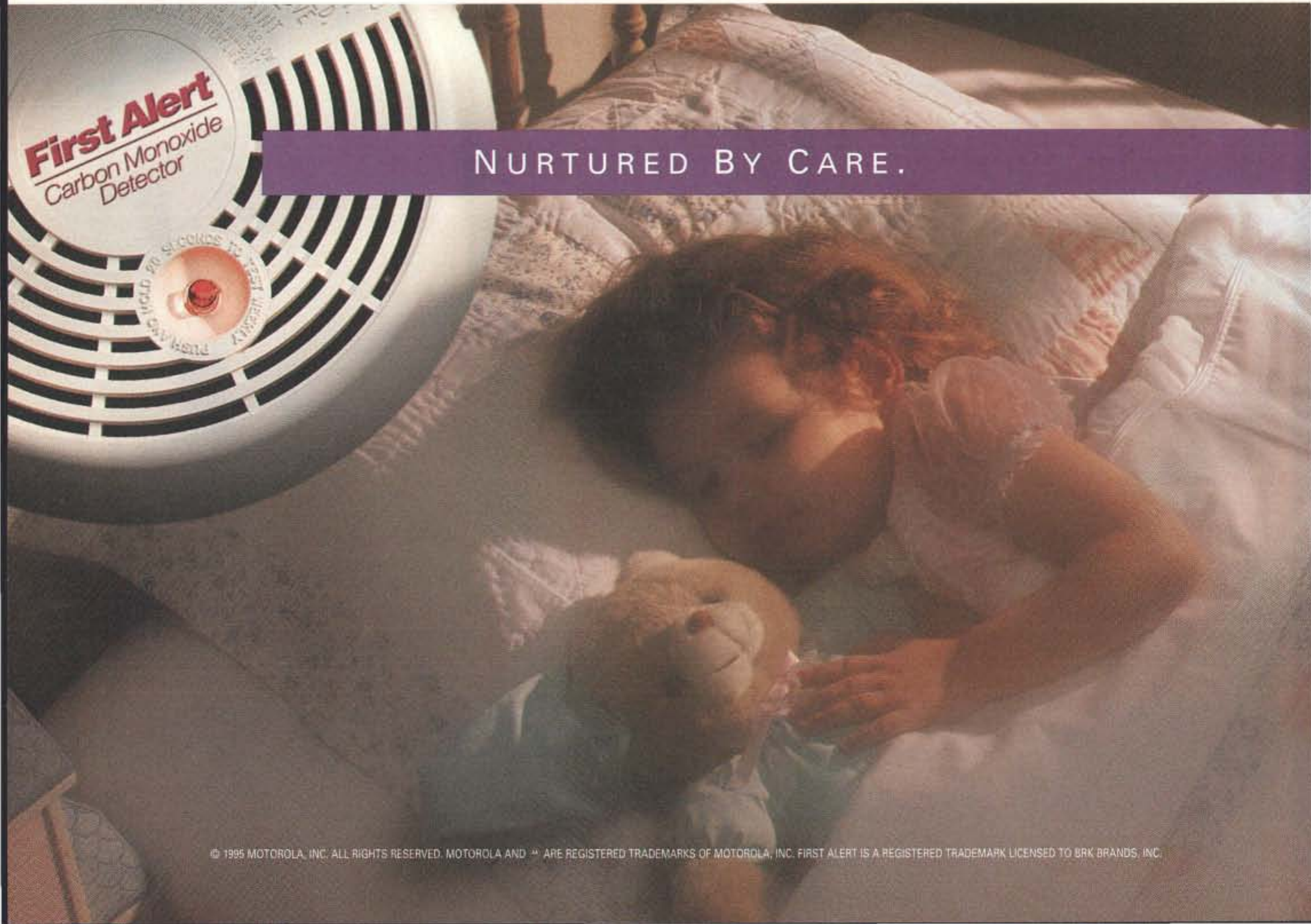
Kastner is not at all surprised by these phenomenal ROI figures. "The first thing you do is skim the cream off the top," he says. "And in this market, there's lots of cream."

The propensity to mine additional profits or a competitive advantage from well-designed warehouses has some advocates talking about the so-called One-Query Theory. Buffum states that "there exists in every shop one query that—if you figure out what it is and implement the knowledge derived from it—will pay for the entire data-warehousing and data-mining system."

Warehouse Sandwich

Parsaye is well known in the data-warehousing field for what's known as his Sandwich Paradigm, a philosophy for building data warehouses that encourages acceptance of the probability that the first iteration of a data-warehousing effort will probably require substantial revision.

Instead of recommending that users buy



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hardware and software, build a data warehouse, and then load their data, the Sandwich Paradigm advises that they pre-mine the data to determine what formats and data are needed to support a data-mining application, build a prototype mini–data warehouse (the "meat" of the sandwich) with most of the features anticipated in the final product, revise the strategies as necessary, and finally build a full warehouse. In this way, problems with poor-quality data or ineffective designs can be rectified before thousands or even millions of dollars are wasted. Often users realize that their data structures are ill-designed, or they gain so much experience with the prototype that they realize that a second chance at building the system could add value that would justify the expense.

To support newly cleansed data, experts advocate maintaining a collection of information about the transformation process. This *meta-data* describes the contents of the data warehouse; where the warehoused data originated; and the translations, aggregations, table lookups, and other transformations that occurred in the warehousing process. For many data-warehousing users, this information becomes critical after the migration is completed, when more detail is needed about a particular group of data or when errors in the warehoused data become evident.

Specific information about successful data-warehousing efforts is sparse, partly because such an effort is complex and extensive, and partly because the companies that succeed are loath to divulge what they perceive as a competitive advantage. It is known, however, that successful data warehouses are usually only half as large as is necessary to support the number of users and applications that quickly become "critical."

When a data warehouse succeeds, more users than initially planned want to employ data mining to their advantage. Data-warehousing and data-mining applications are usually installed with a specific motive in mind, such as fraud detection or profit generation, says Kastner.

But once a data warehouse is installed, the number of users almost always increases with the success of the system. For instance, one department-store chain based in the U.K. implemented a data-mining system to better understand customer-buying trends. Within six months, one of the biggest users of the system was the chain's accounting department, which began tracking profit and loss leaders. Analysts discovered that the shoplifting of batteries, film, and midpriced pens cost the chain $60,000 a month. These products were moved to a more secure store location, saving the chain over $700,000 annually.

One offshoot of the fast-growing data-warehousing and data-mining market is that tool and database vendors are announcing partnerships in record numbers. But "they're not worth the paper they're printed on," warns Kevin Strange, research director for industry analyst the Gartner Group (Stamford, CT). With rare exceptions—such as Platinum Technology (which is creating synergies by acquiring companies such as Trinzic) and Software

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DATA-WAREHOUSE CONSTRUCTION TIPS

- **Accept that your first try will require revision.**
- **Examine your data: What formats and specific data are needed to support your application?**
- **Bite the bullet and clean up your data before using it in the warehouse.**
- **Build a prototype mini–data warehouse as a learning experience and then revise strategies as necessary.**
- **Plan on more users' taking advantage of a successful data warehouse than you initially expected.**
- **Keep storage options in mind: Your data is only going to grow.**

AG (which is creating an initiative among several vendors)—industry partnerships in this market do not benefit customers. But the good news here for buyers is that the efforts made by Software AG and Platinum will force other vendors to create alliances, Strange says, probably by the end of the year.

Parallel Power

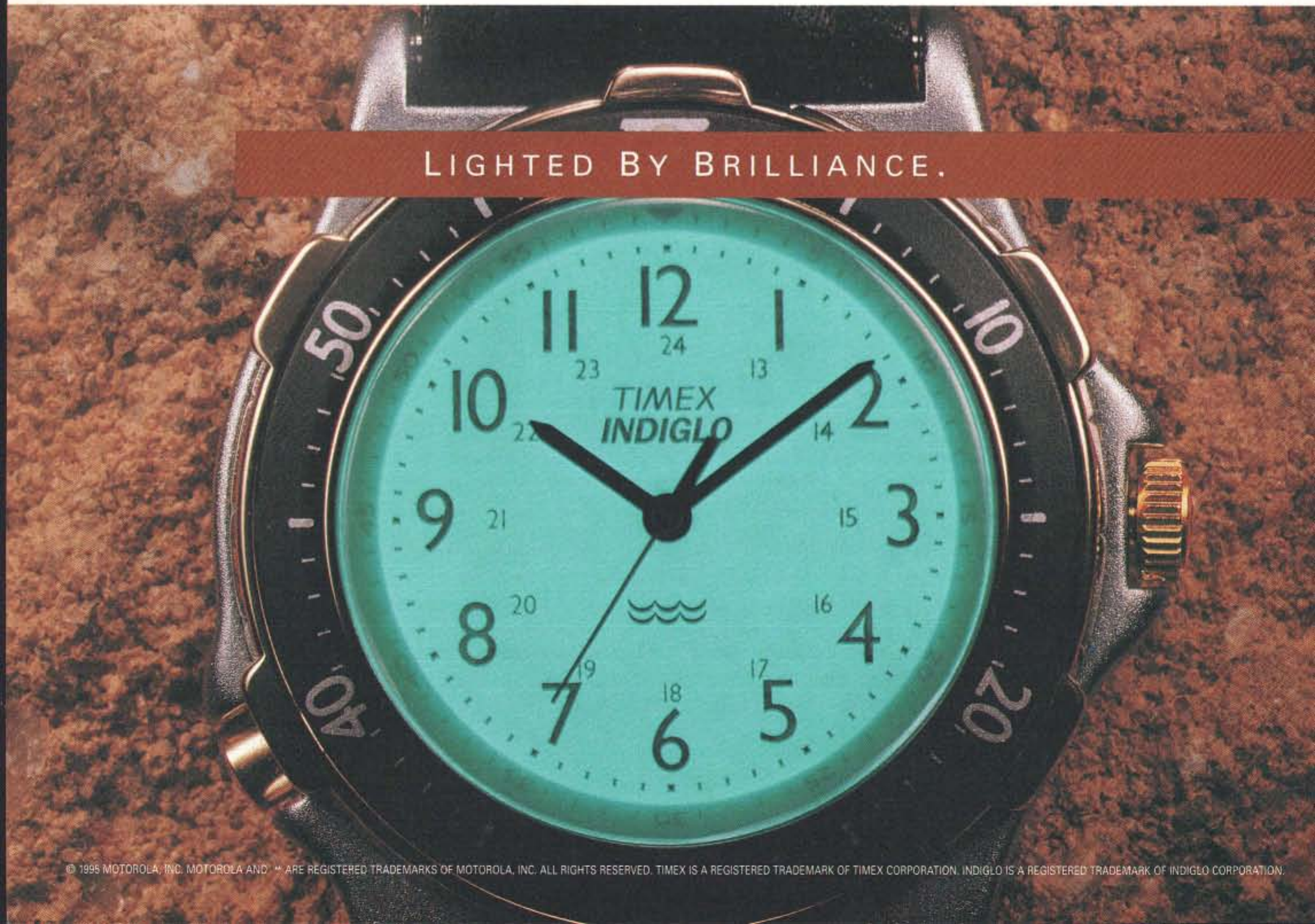
Parallel processing speeds up the work of decision-support systems such as data mining by dividing a complex query into multiple parts and assigning each part to a separate processor. The processors work concurrently, unlike serial processors, which address one process after another.

While data mining is unquestionably being driven by the affordability of highly powerful parallel-processing computers, interest in data mining is also driving parallel sales; it's a synergistic effect. Once the province of the scientific community and its deep-pocketed sponsors, parallel-processing machines have dropped in price by 30 percent to 40 percent annually for the past several years, bringing them into the realm of the affordable.

Parallel-processing systems are available in two distinct flavors: symmetric multiprocessing (SMP) and massively parallel processing (MPP). SMP systems share a common memory among clusters of machines. MPP systems are often called "shared nothing" or distributed-memory systems, because each processor has its own memory.

SMP systems are typically used for smaller data warehouses holding 100 GB of data or less, while MPP machines are necessary once a data warehouse hits 500 GB. The gray area in between is something of a battleground among vendors, who argue points of scalability, cost, and performance.

Clustered SMP systems are well suited to applications with *lumpy data*, which is heavily used for data-mining queries. Because the processors are clustered and memory is shared, no one processor is exclusively assigned to access the key data, thus preventing bottlenecks. In contrast, MPP vendors suggest that sites planning for many users or heavy data volumes use



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MPP systems rather than clustering multiple SMP systems.

Sales of SMP-based systems are projected to be larger than those of MPP systems for the foreseeable future, predominantly because of their lower cost and better scalability, explains Howard Richmond, a vice president of the Gartner Group. Yet the MPP market is also experiencing significant growth, he adds.

Storage: Not the Final Frontier

The last enabling data-mining technology is storage. Once a no-brainer, data storage is now so important that some sites actually keep their storage devices and data under the protection of armed guards.

With data warehouses storing gigabytes and terabytes of data, and projections calling for warehouses holding hundreds of terabytes within five years, affordable storage technology is key to serious data mining. Disk-storage prices, which had been falling an average of 30 percent to 40 percent annually, are falling even faster so far this year, and storage vendors are running hard to stay even.

Like processing, storage technologies such as RAID (an acronym for redundant arrays of independent disks) are becoming increasingly parallel. The concern of many industry watchers is the lack of a faster technology for reading data off a storage disk. There are no new storage technologies on the horizon as yet, which could make storage a bottleneck for data-mining applications as queries become more complex, storage volumes increase, and parallel machines get faster.

Pot of Gold

Every business will have a data warehouse in 10 years, predicts Kastner, whether it's the company's custom warehouse or one that's available through wideband networks connected to desktop systems. The benefits of knowing one's business and customers will become so critical that the technology will be positively pervasive, he adds.

Previously unrelated technologies are coming together to support data mining. That can only make data mining easier. ■

Cheryl D. Krivda is a technical journalist based in Perkasie, Pennsylvania, specializing in information-technology topics. She can be contacted on the Internet at 5309513@mcimail.com or on BIX c/o "editors."

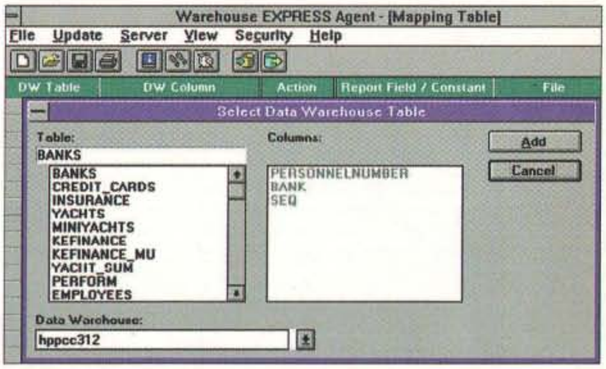

Table: BANKS

Data Warehouse: hppcc312

Software AG's SourcePoint Administrator lets a user select a table from the warehouse and map columns to fields from the extract process.

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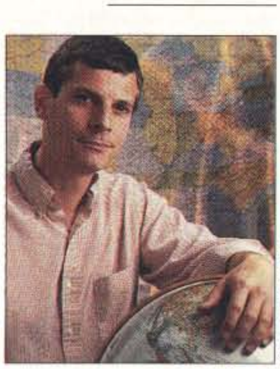


AL KARVEY © 1995

Here's how BYTE remade a postcard-based reader survey into a Common Gateway Interface–based Web application

Smuggled onto your PC, in the guise of a multimedia viewer, your World Wide Web browser is actually an all-purpose client that runs applications on a vast global network. Likewise, your Web server, justified to your company's controller as a marketing tool, can act as an applications server that connects you to customers, suppliers, and business partners.

One of the most popular uses of this new client/server model is the on-line survey. If you read BYTE in the 1970s and/or 1980s, you may recall BYTE's Ongoing Monitor Box, more commonly known as the BOMB. It was a page that reported how readers ranked the previous month's articles, together with a postcard that solicited feedback on the current issue.

The BOMB fizzled years ago, and we've missed it. The advent of the BYTE Web site set the stage for a 1990s remake. To try it, surf on into http://www.byte.com and go to any article in our archive. Along with the standard links across the top of each page, you'll find one labeled "Comment." Click on it to invoke a Hypertext Markup Language (HTML) form with multiple-choice questions and space for comments.

Our archive isn't just an electronic publication now; it's also an application. What follows is a look at how we put it together and how you can build one like it.

Step 1: Make the Form Context-Sensitive

The first task was to make the Web BOMB context-sensitive. If you're reading a story on-line and decide to comment on it, the form that pops up when you click on the Comment button will display a title such as "February 1995 / News & Views / Optical Drives." These same three items—the story's issue, section, and title—will also appear in the database record that's created when you submit the form.

Since the archive has 1500 documents, must there also be 1500 forms? Actually, there are none. As is common practice, the Web BOMB relies on a Perl script to print the forms on demand. What activates that Perl script? The Comment link on each of the 1500 pages. So, while I didn't have to write 1500 forms, I did need to write 1500 links that look like this:

```
<a href=/cgi-bin/perl.exe?\
cmt1.pl+9502+News_&_Views+\
Optical_Drives>Comment</a>
```

This code says: "When the Comment link is clicked on, launch the Perl interpreter, feed it the HTML-form-writing Perl script cmt1.pl, and in turn feed cmt1.pl three arguments—the issue, section, and title of the current article."

These links are far more concise than the forms that cmt1.pl generates, but it still wouldn't have been practical to write 1500 of them by hand. But then, I don't write any of the archive's HTML source by hand. An Epsilon Extension Language (EEL) program (see part A of the figure "Anatomy of the Web BOMB" on page 106) does that for me, and one additional `printf` statement was all it took to put a context-sensitive comment link on every page in the archive. Part B of the figure shows the EEL program's output—the HTML source for a page. Part C illustrates how a browser renders that HTML source.

Step 2: Print the Form

When you click on the Comment button, the Web server invokes cmt1.pl and relays its output—an HTML form—back to your browser. The cmt1.pl script begins as shown in part D of the figure. The first line prints the standard Common Gateway Interface (CGI) header. The second line saves the uniform resource locator (URL) of the article that prompted the comment, so the form-processing script (cmt2.pl) can offer the user a link back to the article.

HTTP_REFERER is the charmingly misspelled CGI environment variable that contains the URL of the referring document—in this case, the article on which the Comment link appears. Note how the name HTTP_REFERER keys into the associative array (i.e., the list of name-value pairs) that Perl uses to represent environment variables. Each of the next three lines takes an argument from the Perl command line, saves it in a variable, and turns underscores (which are inserted at the EEL stage to make multiword arguments behave atomically) back into spaces.

The cmt1.pl script then prints the HTML document that your browser renders as the Comment form. It incorporates the issue, section, and title variables into the document's header. Then it begins writing the form as the body of the document. The opening phrase of the HTML form element says: "On completion of this form, launch the Perl interpreter, feed it the form-processing script cmt2.pl, and in turn feed cmt2.pl four arguments. Transmit the data collected on the form to cmt2.pl by way of a file (`method=post`) rather than on the command line (`method=get`)."

The rest of cmt1.pl completes the form. HTML can describe interactive GUI controls, such as check boxes, radio buttons, drop-down listboxes, and single- or multiple-line text boxes. The Web BOMB just uses a series of check boxes for the multiple-choice questions, and a multiline text box for the free comments. The figure shows some of the HTML source that creates the multi-

ANATOMY OF THE WEB BOMB

Common Gateway Interface (CGI) programming involves peculiar flows of control and data. Follow the solid black arrows to trace the flow of control from programs to documents to programs to documents as the Web BOMB works. Follow the red, numbered circles to trace the flow of the three items of data—the article's issue (1), section (2), and title (3)—that make the Web BOMB context-sensitive.

A

Don't even think about publishing a large collection of documents on the Web unless you can automatically generate those documents.

I could have used Perl for this job, but Epsilon's EEL seems even better. I like how EEL supports both declarative and navigational text processing. You can do the same kinds of global regular-expression searching and replacing that Perl can do. But you can also programmatically wield all the navigational and interactive powers of a text editor: searching forward and backward, inserting text, and jumping to locations.

B

HTML, like PostScript, is a language that should mostly be written by programs rather than by humans. Unlike PostScript, though, HTML is easy to write. That makes Web development very convenient.

When you want to use a program-generated form like this one, first write it out by hand and test it in your browser. When it works the way you want, you've got a specification for the document that your program must write.

C

You launch a CGI program by clicking on a link. Here the link is textual—it's the word *Comment*. To create this kind of link, you write HTML source like this:

Comment

Alternatively, you can make the link graphical. To do that, you write HTML source like this:

<img src=cmt.gif>

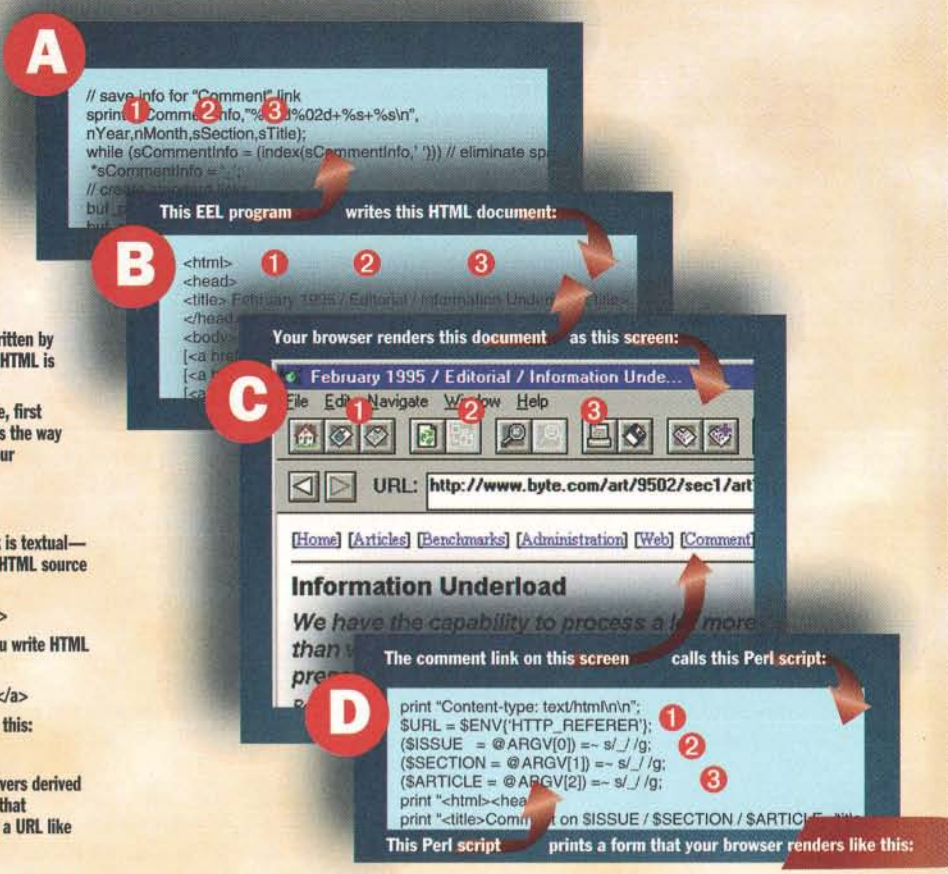
Note: With most Web servers, the CGI link actually looks like this:

<a href=/cgi-bin/cmt2.pl?args>

Invocation of the Perl interpreter is implicit. However, NT servers derived from EMWAC's code require explicit invocation of Perl. Isn't that dangerous, I wondered? What's to keep a user from entering a URL like

http://www.byte.com/cgi-bin/perl.exe?-e+unlink+*.*

using Perl's "enter a line of script on the command line" feature to trash a bunch of files—or worse? Process Software agreed this is a problem, and it will have a fix in Purveyor 1.1.


A
1
2
3
This EEL program
writes this HTML document:
B
1
2
3
Your browser renders this document
as this screen:
C
1
2
3
The comment link on this screen
calls this Perl script:
D
1
2
3
This Perl script
prints a form that your browser renders like this:

```
// save info for "Comment" link
sprin  Comm  nfo,"%  d%02d+%s+%s\n",
nYear,nMonth,sSection,sTitle);
while (sCommentInfo = (index(sCommentInfo,' '))) // eliminate sp
 *sCommentInfo = '_';
```

```
<html>
<head>
<title> February 1995 / Editorial / Information Under
```

February 1995 / Editorial / Information Unde...

File Edit Navigate Window Help

URL: http://www.byte.com/art/9502/sec1/art

[Home] [Articles] [Benchmarks] [Administration] [Web] [Comment]

Information Underload

We have the capability to process a lot more

```
print "Content-type: text/html\n\n";
$URL = $ENV{'HTTP_REFERER'};
($ISSUE   = @ARGV[0]) =~ s/_/ /g;
($SECTION = @ARGV[1]) =~ s/_/ /g;
($ARTICLE = @ARGV[2]) =~ s/_/ /g;
print "<html><hea
print "<title>Comm  t on $ISSUE / $SECTION / $ARTIC
```

D

Web servers communicate a number of environment variables to back-end CGI programs. Here, Perl gets the referring article's URL from the HTTP_REFERER variable. It will be a string like this:

http://www.byte.com/art/9502/sec1/art1.htm

Separately, Perl saves the issue, section, and title information passed to it on the command line.

ple-choice questions (part D) and the resulting form as displayed in a browser (part E). The cmt1.pl script ends this way:

```
print "<input type=submit value=
       Send><input type=Reset>
     </form></body></html>";
```

The input tags specify two buttons. The first submits the form to cmt2.pl for processing, and the second resets the form. The final three tags close the form element, the document's body, and the document.

Step 3: Process the Form

When you fill out the form and click on the Send button, the Web server launches the back-end CGI program named in the form's `action=` statement: cmt2.pl. Its first two lines (see part F of the figure) say: "Include CGI support routines; call one of them, `ReadParse`, to locate the file in which the server placed the completed form's data; and transfer the name-value pairs stored there into a Perl associative array called 'input.'" Using the names of form variables as keys into the array, cmt2.pl then takes the values of the form variables and puts them into Perl variables, as shown in part F of the figure.

With the form data in hand, cmt2.pl can now rule on whether to accept the form. The Web BOMB presents a form in three parts—questions about the article, questions about the reader, and free comments—but requires only that you complete the first section. If you don't, at least one of that section's form variables will be null. The cmt2.pl script notifies you if that's the case.

How? A conventional GUI program pops up a dialog box, but CGI programs can communicate with users only by way of HTML, so cmt2.pl must format its "need more info" message as an HTML

BOOKNOTE

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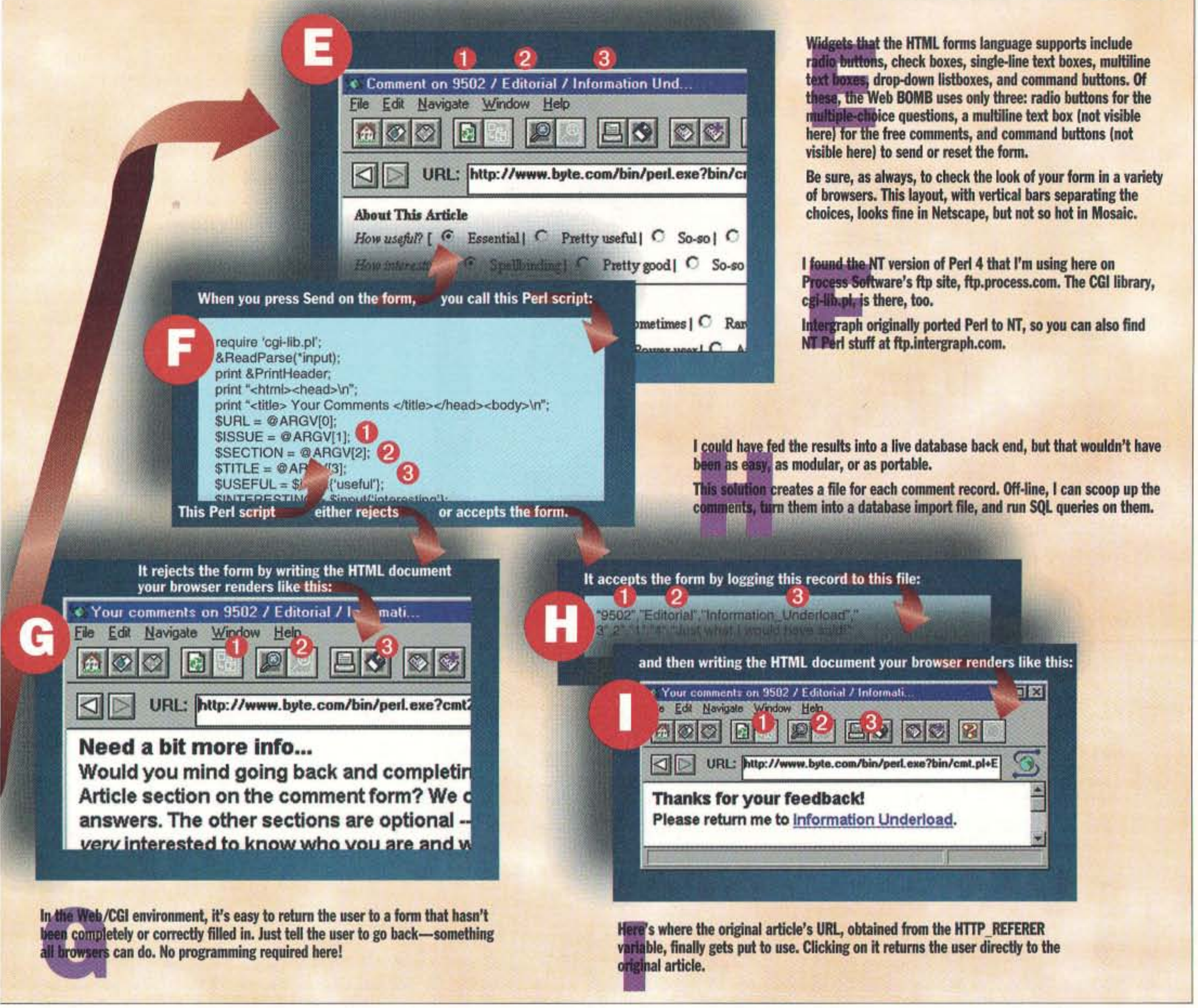
A fat cookbook full of useful recipes. Shows how to acquire and set up the CERN (the European Laboratory for Particle Physics) and National Center for Supercomputing Applications (NCSA) Web servers. Discusses HTML 2.0 and 3.0, teaches basic CGI programming, and offers an advanced tutorial on rolling your own Web clients and servers.


E
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2
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Comment on 9502 / Editorial / Information Und...
File Edit Navigate Window Help
URL: http://www.byte.com/bin/perl.exe?bin/c
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URL: http://www.byte.com/bin/perl.exe?cmt2
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URL: http://www.byte.com/bin/perl.exe?bin/cmt.pl+E

About This Article

How useful? [● Essential | ○ Pretty useful | ○ So-so | ○

How interesti ● Spellbinding | ○ Pretty good | ○ So-so

Widgets that the HTML forms language supports include radio buttons, check boxes, single-line text boxes, multiline text boxes, drop-down listboxes, and command buttons. Of these, the Web BOMB uses only three: radio buttons for the multiple-choice questions, a multiline text box (not visible here) for the free comments, and command buttons (not visible here) to send or reset the form.

Be sure, as always, to check the look of your form in a variety of browsers. This layout, with vertical bars separating the choices, looks fine in Netscape, but not so hot in Mosaic.

When you press Send on the form, you call this Perl script:

```
require 'cgi-lib.pl';
&ReadParse(*input);
print &PrintHeader;
print "<html><head>\n";
print "<title> Your Comments </title></head><body>\n";
$URL = @ARGV[0];
$ISSUE = @ARGV[1];
$SECTION = @ARGV[2];
$TITLE = @AR  [3];
$USEFUL = $   {'useful'};
$INTERESTIN  = $input{'interesting'};
```

This Perl script either rejects or accepts the form.

I found the NT version of Perl 4 that I'm using here on Process Software's ftp site, ftp.process.com. The CGI library, cgi-lib.pl, is there, too.

Intergraph originally ported Perl to NT, so you can also find NT Perl stuff at ftp.intergraph.com.

It rejects the form by writing the HTML document your browser renders like this:

Your comments on 9502 / Editorial / I   mati...

Need a bit more info...

Would you mind going back and completir Article section on the comment form? We c answers. The other sections are optional -- *very* interested to know who you are and w

In the Web/CGI environment, it's easy to return the user to a form that hasn't been completely or correctly filled in. Just tell the user to go back—something all browsers can do. No programming required here!

I could have fed the results into a live database back end, but that wouldn't have been as easy, as modular, or as portable.

This solution creates a file for each comment record. Off-line, I can scoop up the comments, turn them into a database import file, and run SQL queries on them.

It accepts the form by logging this record to this file:

```
"9502","Editorial","Information_Underload","
3","2","1","4","Just what I would have said!"
```

and then writing the HTML document your browser renders like this:

Your comments on 9502 / Editorial / Informati...

Thanks for your feedback!

Please return me to Information Underload.

Here's where the original article's URL, obtained from the HTTP_REFERER variable, finally gets put to use. Clicking on it returns the user directly to the original article.

TOOLWATCH

Submit It

http://www.cen.uiuc.edu/~banister/submit-it/

Once you've built a Web site, you'll want to publicize it. Where? On Yahoo, Lycos, WebCrawler, and a dozen other well-known sites. You can visit each of these in turn...or you can have Scott Banister's Submit It act as your publicity agent.

document that it relays back to you by way of the server.

How does the Web BOMB redisplay the form so you can complete the required fields? That's easy. The "need more info" document (part G of the figure) tells you to use your browser's "go back" function, which reloads the form. When you complete the form to cmt2.pl's satisfaction, it logs the data (part H) and returns a "thanks for your input" document (part I).

From there, you could unwind the document stack using the "go back" function, but it's more convenient to jump straight to the article that prompted the comment, so cmt2.pl supplies a link to it. This is where the article's URL, which cmt1.pl got from the HTTP_REFERER environment variable and passed to cmt2.pl, finally comes into play.

Step 4: Log the Data

When I first envisioned the Web BOMB, I thought it should pump the survey results into a relational database. This client/server scenario, in which clients connect through HTML forms to relational servers, represents the most compelling (and, to vendors of SQL front-end toolkits, the most frightening) aspect of Web/CGI technology. Since a survey isn't a transactional application, though, implementing the Web BOMB this way seemed like overkill. Users would pay an unnecessary performance penalty, and I'd end up with an application that was more complex and less portable than it had to be.

Instead I opted for a simpler, more modular solution. Rather than inserting a record into a database, cmt2.pl logs data by writing a line of text to a file, as shown in part H of the figure. As my Perl mentor Ben Smith likes to say, "If every record is a file, record locking isn't a problem."

How do you analyze the data? That's easy. Combining all the comment files yields a comma-delimited ASCI import file that FoxPro, dBase, or almost any other database program can read. Then you can answer questions such as "How did

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the interest in reviews vary by month?" or "What were the top 10 articles?" with straightforward SQL queries.

Next-Generation Client/Server?

Like the thousands of CGI programs on the Internet, the Web BOMB exhibits four desirable properties: *client-server*, because your browser interacts with our server; *cross-platform*, in that Windows, OS/2, Mac, and Unix clients can connect to any of these flavors of servers; *WAN*, since clients connect to servers over the Internet; and *rapid application development (RAD)*, because it's a snap to build.

Web technology isn't just a way to publish electronic documents. It's also a way to build networked applications that work within and across corporate boundaries. But it isn't yet a client/server developer's dream. I realized this when, in parallel with the Perl version of the Web BOMB, I prototyped a Visual Basic version using the nifty Windows CGI that's unique to O'Reilly and Associates' WebSite.

In principle, this sounds great: VB, the preeminent RAD tool, has to be the ultimate enabler for Web development, right? Well, maybe not. It's true, as O'Reilly's documentation says, that VB's a great way to get at data that's available through Windows APIs, such as OLE and Open Database Connectivity (ODBC).

But that's not necessarily a VB exclusive. A Win32 version of Perl, for example, could also wield these strategic APIs. On a level playing field, I'll choose Perl: For the text-processing chores typical of CGI applications, Perl's far more capable than VB.

What makes VB great are its plug-in user-interface (UI) components, such as the data-bound controls that have revolutionized client/server database development. However, Web-aware VB custom controls (VBXes) and OLE custom controls (OCXes) don't exist yet, and even if they did, today's browsers couldn't host them.

Browsers and components will evolve in this direction. Meanwhile, Sun Microsystems' Java/Hot Java technology has the potential to trigger a revolution like the one that VB touched off. Java's a language that describes Web applets; Hot Java's a browser that has the ability to download and run them. One way or another, strategic networked applications will increasingly run on the Web. ■

Jon Udell (judell@bix.com) is BYTE's executive editor for new media.

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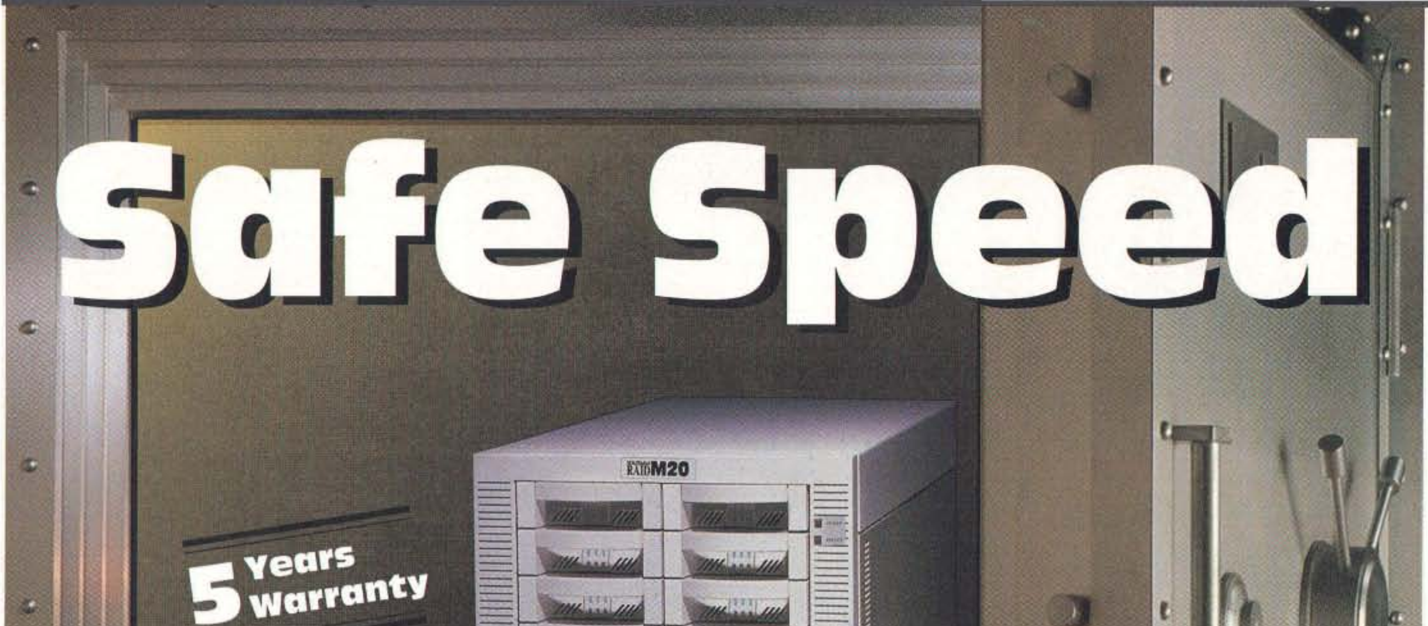

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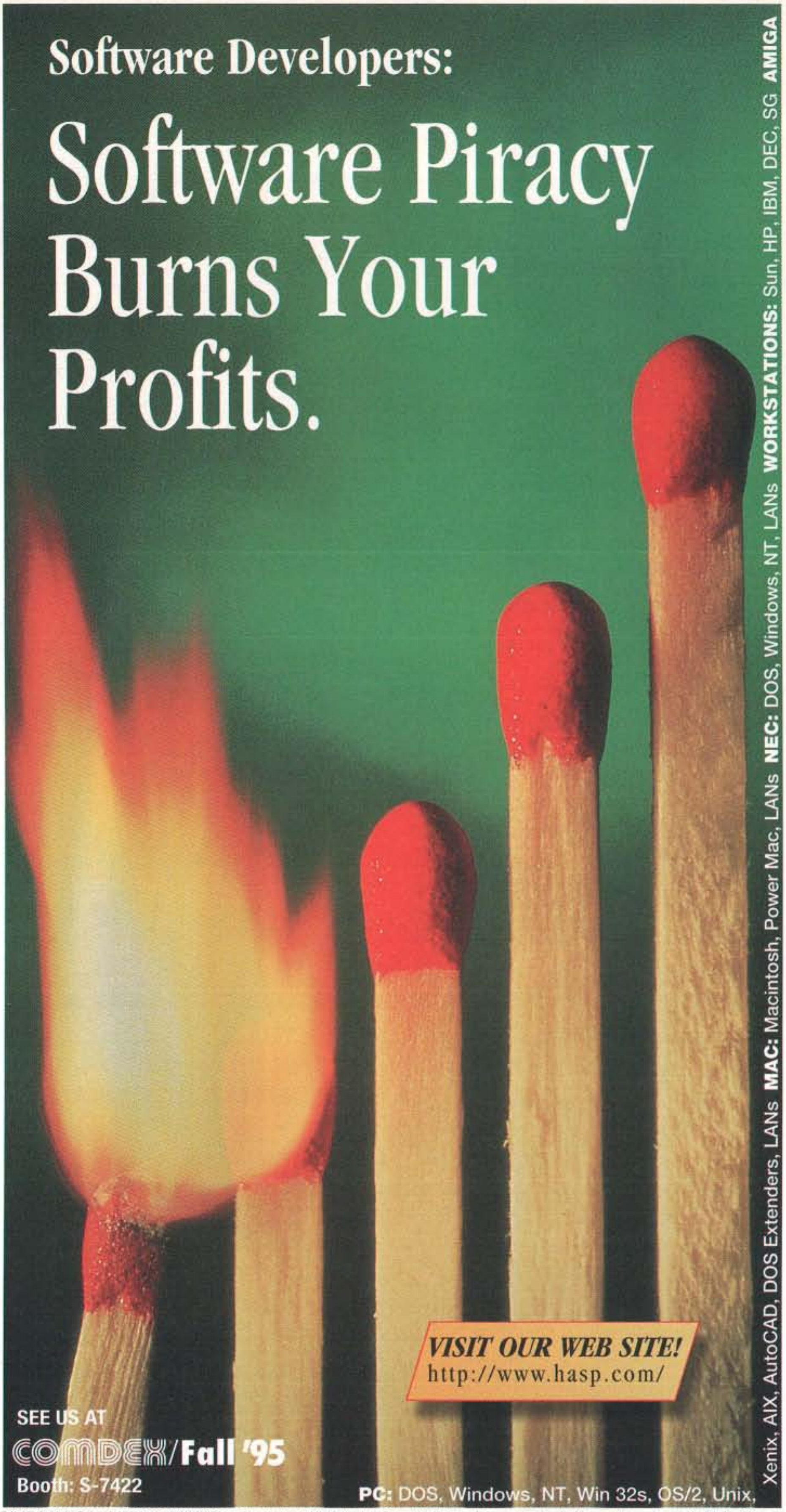

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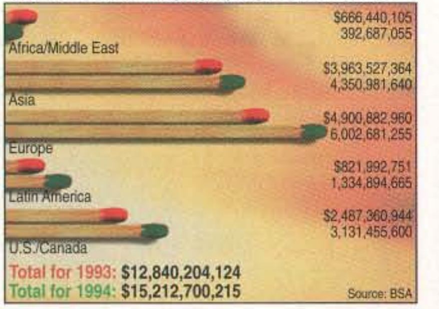

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Windows 95: The Numbers

The new Windows architecture delivers enhanced performance, but as BYTE testing reveals, there are strings attached

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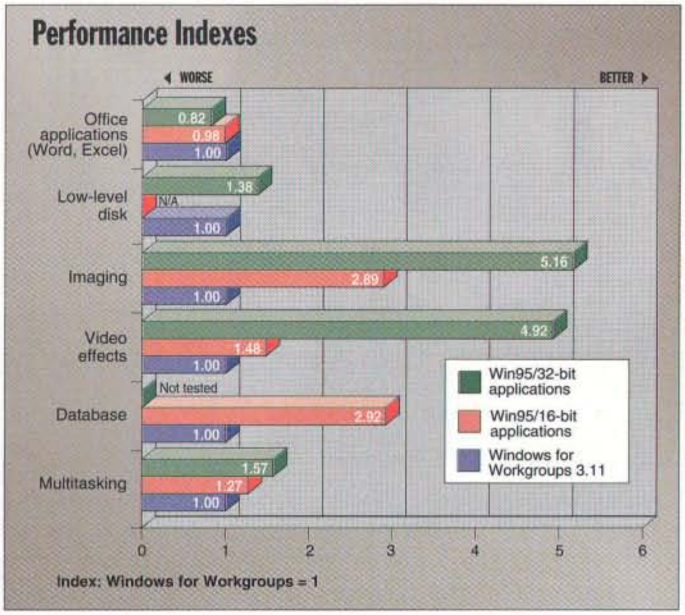
The wait is not yet over for Windows 95. Yes, it has finally shipped, but we still don't have applications that take full advantage of its 32-bit, multithreaded architecture. In extensive testing of the shipping Windows 95 code, we came to a few solid conclusions:

- You won't see a dramatic performance improvement when running your existing 16-bit applications under Windows 95.
- Those 32-bit applications that are not fully optimized for Windows 95 will realize only marginal performance enhancements under the new platform.
- Applications that load large files (e.g., multimedia, imaging, and databases) take full advantage of 32-bit data paths and display the greatest performance gains.
- The Windows 95 environment multitasks applications much more smoothly and with greater stability than Windows for Workgroups 3.11 (WfWG) does.
- Windows 95 requires more memory than previous versions of Windows to run optimally, but for most office applications, the performance gains level off at 16 MB.

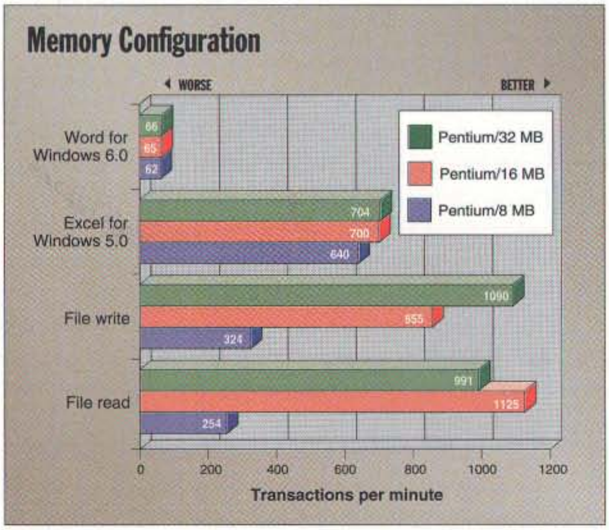
The graph of indexed performance (right) charts the big picture. Office applications (i.e., Word and Excel) display no speed enhancement on the new platform, even when tested with the shipping 32-bit applications. The speed improvements stand out on the tests that take advantage of 32-bit data paths.


Performance Indexes

Required RAM

Don't even try to deploy Windows 95 on systems that pack less than 8 MB of RAM. And if you can afford the upgrade to 16 MB, you will appreciate the improved performance.

Of course, if your applications require a large memory footprint, then 16 MB of RAM may not hack it; but for most office applications, 16 MB is sufficient. Upgrading beyond that level won't buy you much additional speed. For testing memory configurations, NSTL used a Digital Equipment Celebris SL 590 (a 90-MHz Pentium); all other tests in this report were run at BYTE on a Gateway 2000 486DX2/66 with 16 MB of RAM.


Memory Configuration

32 Bits Is Not Enough

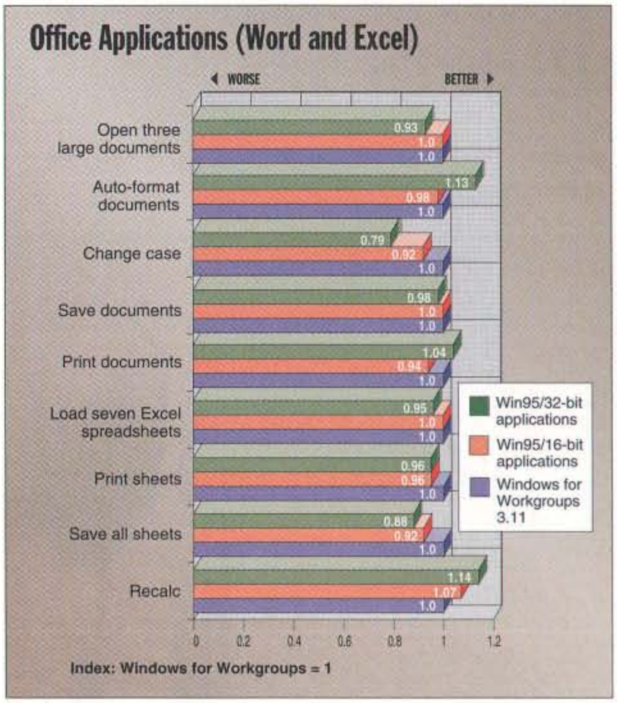
The performance of 32-bit Office 95 applications is disappointing, but this is not the best indicator of overall Windows 95 performance enhancements. Once Microsoft turns its attention to 32-bit optimization for its suite, the performance numbers should improve. "Microsoft has optimized the Office applications like crazy for the 16-bit architecture of Windows 3.1," Andrew Hudson points out. He is president of North Coast Software, an imaging company that develops extensively for Windows 3.1, Windows 95, and multiple NT platforms, including PowerPC. "They just haven't had the time to do the same optimizations for Windows 95," he adds.

Even with the current Office 95 release, you should notice snappier operation because of improved multitasking and features such as on-the-fly spell-checking and threaded print services. In future Office releases, Microsoft plans to move additional processes into independent threads. These enhancements, along with aggressive optimization, are the kinds of improvements that applications vendors will have to make to boost performance. The OS alone won't do the trick.

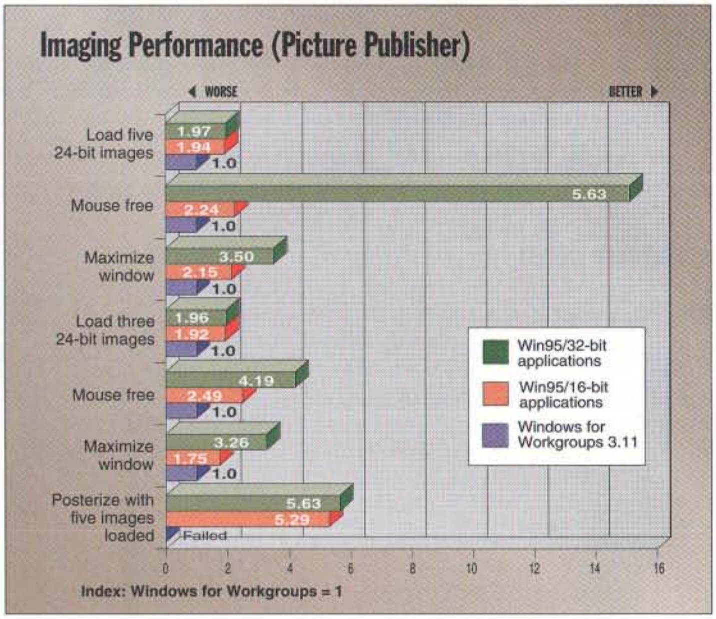
Imaging and Multimedia

The most striking performance gains of Windows 95 came in our imaging and multimedia tests. Picture Publisher 6.0 not only supports 32-bit data paths but also spawns threads for each image loaded, letting you resume work more quickly. When we loaded five 24-bit images with Picture Publisher 6.0, the mouse was free after just 8 seconds, giving us control of the system to multitask. Under the same scenario using WfWG and Picture Publisher 5.0, we didn't get mouse control for over 2 minutes. In another show of stability, Windows 95 had no trouble running the posterize test with the five images loaded, but

Windows 95: The Numbers


Office Applications (Word and Excel)

Index: Windows for Workgroups = 1


Imaging Performance (Picture Publisher)

Index: Windows for Workgroups = 1

WfWG froze the system each time we tried to run the same test.

PhotoMorph displayed the most dramatic speed improvements when it was upgraded to the Windows 95 version. The video-effects creation tool uses extensive 32-bit moves and floating-point calculations (an area Microsoft reportedly focused on in Windows 95 after the Pentium bug was revealed).

Multitasking: The Big Win

Anyone who has ever experienced an "application is not responding" crash under Windows will appreciate the improved multitasking of Windows 95. Our multitasking tests show only a marginal improvement in the speed of multiple applications running under Windows 95; but the new environment, with its preemptive multitasking architecture, is clearly more stable.

For our first multitasking suite, we loaded three Word documents, seven linked Excel spreadsheets, and three 24-bit images. We formatted one of the Word documents and saved it while recalculating the linked spreadsheets. WfWG froze each time we ran the suite, crashing one of the three loaded applications in each case. We reran the test with two images loaded (instead of three) and still could not complete the test under WfWG. WfWG finally ran the suite with a single 24-bit image loaded; the timings are recorded as suite 2.

For suite 3, we copied approximately 20 MB of files from a double-speed CD-ROM drive to the hard disk while compiling a video effect with PhotoMorph 2. Suite 4 included loading a document into Word and recalculating our linked Excel spreadsheets while building a 7-MB archive with WinZip.

Under both testing environments, we left 80 MB of disk space free and defragmented the disk before launching a multitasking test. We created the largest permanent swap file that WfWG would allow and kept the default settings of Windows 95 to enable the new dynamic cache (see the Technology Focus box "The Installable File System" below). In all cases, we ran the WfWG tests and the Windows

TECHNOLOGY FOCUS

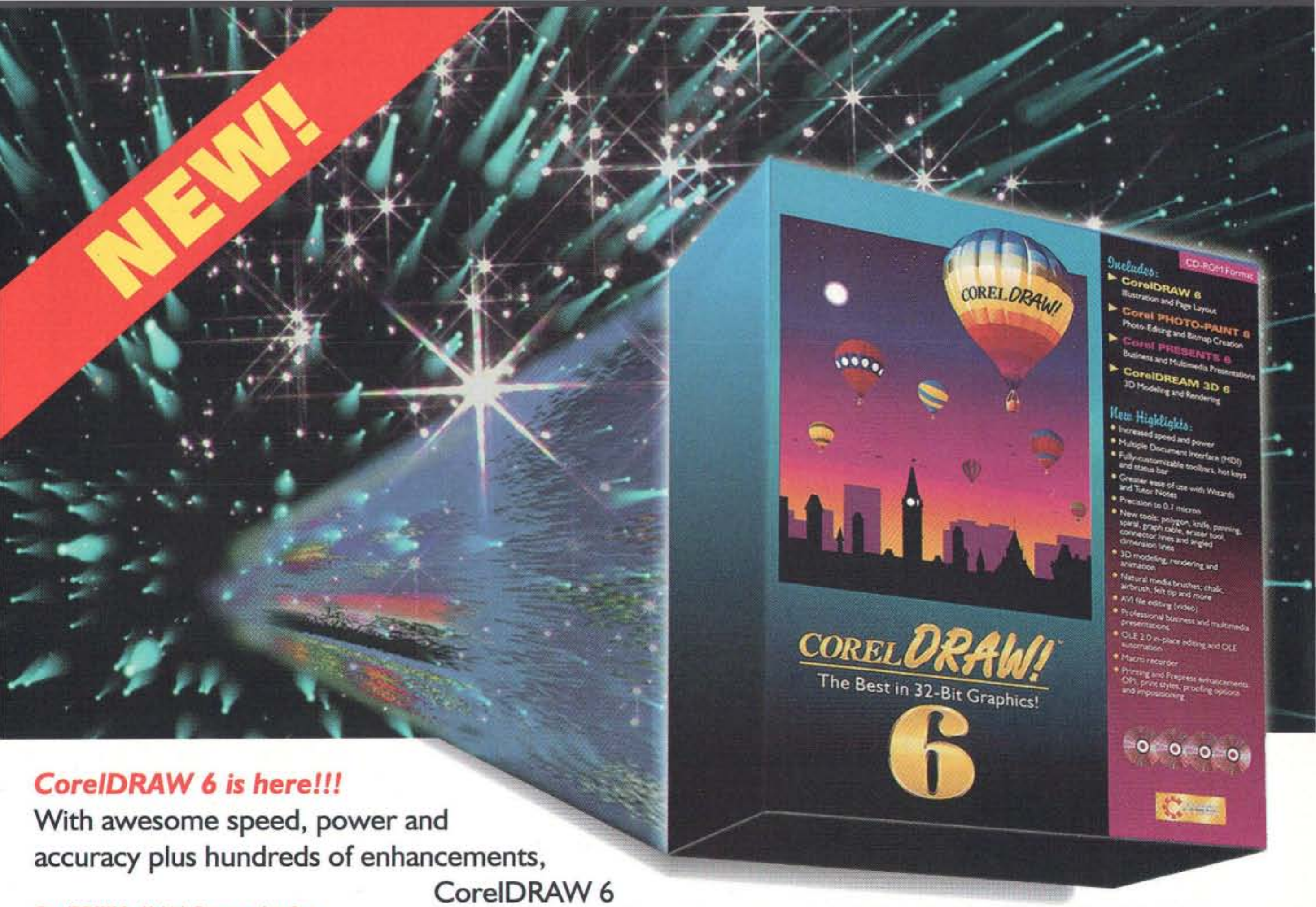
The Installable File System

A key architectural component of Windows 95 is its layered installable file system (IFS). Under MS-DOS and Windows 3.1, applications and system components that needed to handle file I/O requests had to hook into INT 21h to examine and evaluate those requests. Windows 95 supports file-system drivers as ring 0 components, instead of as real-mode MS-DOS drivers. In addition to the performance and reliability advantages of a 32-bit protected-mode architecture, the IFS can support multiple network redirectors for simultaneous access to different networks. Windows 3.1 could support no more than two network redirectors at a time.

The IFS supports the 32-bit virtual file allocation table (VFAT) driver, the 32-bit CD-ROM file system (CDFS) driver, and integrated 32-bit network redirectors for Windows NT and NetWare servers. With an IFS, third-party vendors can add file systems under the IFS Manager—for example, to support other network OSes (NOSes).

Applications and system components can now access the hard disk file system through VFAT, a 32-bit protected-mode driver that is reentrant and multithreaded. In addition, the Windows 95 block I/O system supports a 32-bit, protected-mode port driver for communicating to specific drive controllers. For SCSI devices, Windows 95 integrates a SCSI layer to handle high-level SCSI calls. The combination of VFAT and the block I/O system opens a protected-mode 32-bit code path to hard disk files.

The VFAT also supports the new caching architecture of Windows 95. VCACHE, a 32-bit protected-mode cache driver that replaces real-mode SmartDrive, dynamically allocates memory for disk caching. CDFS replaces real-mode MSCDEX and requires no conventional memory. The CDFS cache shares its memory pool with the VFAT driver and, like VCACHE, is dynamic. During heavy CD-ROM usage, the system allocates more memory to the CDFS cache and returns the memory when an application requires it.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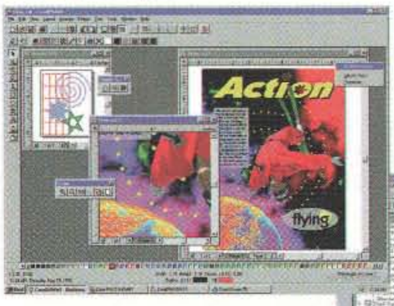

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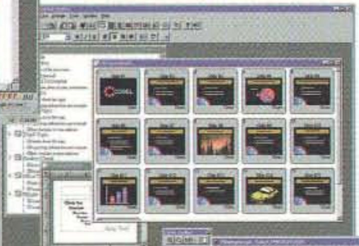

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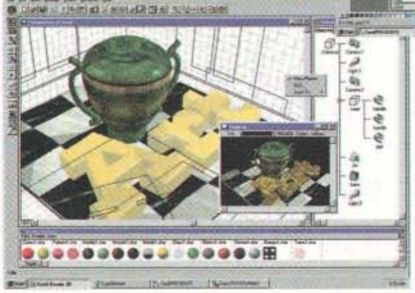

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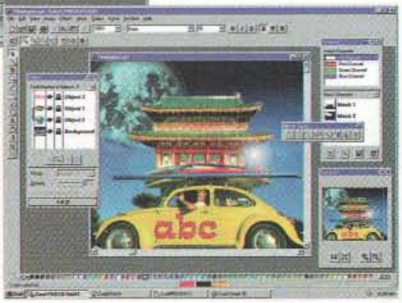

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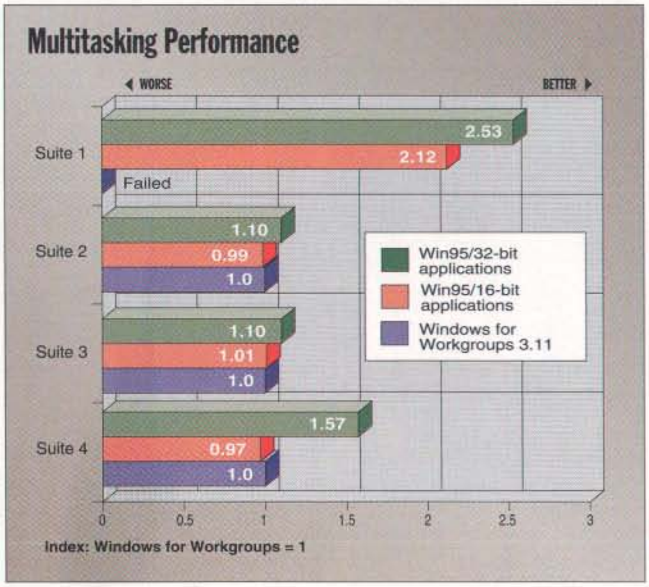

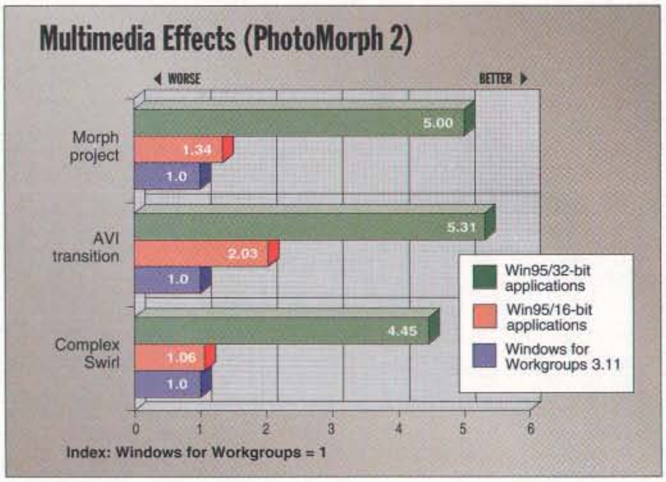

95/16-bit tests with shipping 16-bit applications. The Windows 95/32-bit multitasking suites were run entirely with 32-bit applications (i.e., gold code of Word and Excel for Windows 95; beta code of PhotoMorph 2, Picture Publisher 6.0, and WinZip32).

If You Build It, They Will Come

With the right memory configuration and optimized applications, Windows 95 looks like a clear performance winner over Windows 3.1. The bigger win is stability, which has long been a sore point for all of us who do serious work with Windows. As developers start optimizing 32-bit code for Windows 95 and supporting multithreaded processes, the performance will only get better. ■

Stanford Diehl is the director of BYTE product reviews. He has been testing and evaluating computer software and hardware for over 10 years. Before coming to BYTE, he developed computer-based training and database applications for a large industrial contractor. You can reach him on the Internet or BIX at sdiehl@bix.com.

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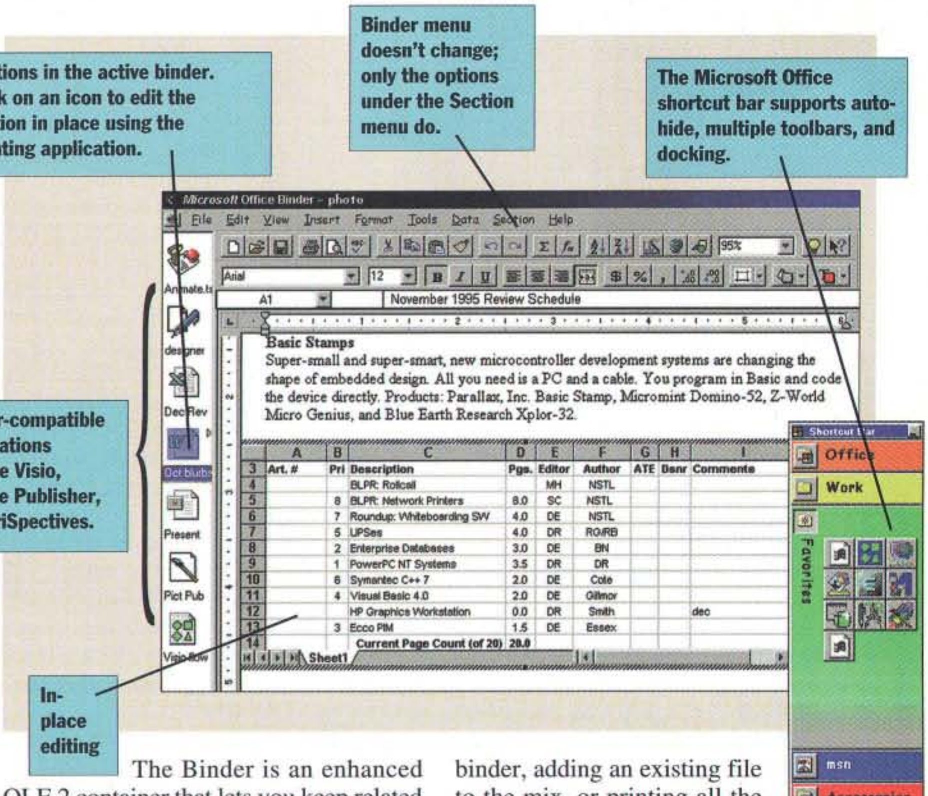
Applications 95 Arrive

Hot new programs that make Win95 worth the upgrade

STANFORD DIEHL

It was classic. At last June's Reviewers Workshop in Seattle, the Microsoft spin doctors downplayed the hype (that they had helped fuel over the last two years or so) surrounding Windows 95 and tried to lower expectations. It's just an OS, the line went, "not a cure for cancer." They are right, of course: It is just an OS, and—as IBM learned—no OS can thrive in a vacuum.

Only powerful productivity applications can infuse a new platform with value. And Windows 95 has the applications to bring it all together. By the traditional definition of a killer app—high-profile productivity software that drives the acceptance of a new technology or system—the beta applications covered here can rightly claim killer-app status. This new software taps into the unique features of Win95 and performs tricks that weren't possible under Windows 3.1.



Sections in the active binder. Click on an icon to edit the section in place using the creating application.

Binder menu doesn't change; only the options under the Section menu do.

The Microsoft Office shortcut bar supports auto-hide, multiple toolbars, and docking.

Binder-compatible applications include Visio, Picture Publisher, and TriSpectives.

In-place editing

November 1995 Review Schedule

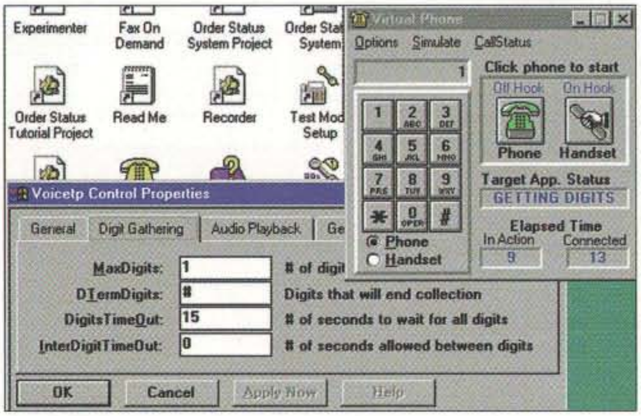
Basic Stamps
Super-small and super-smart, new microcontroller development systems are changing the shape of embedded design. All you need is a PC and a cable. You program in Basic and code the device directly. Products: Parallax, Inc. Basic Stamp, Micromint Domino-52, Z-World Micro Genius, and Blue Earth Research Xplor-32.

	A	B	C	D	E	F	G	H	I
3	Art. #	Pri	Description	Pgs.	Editor	Author	ATE	Bsnr	Comments
4			BLPR: Rollcall		MH	NSTL			
5		8	BLPR: Network Printers	8.0	SC	NSTL			
6		7	Roundup: Whiteboarding SW	4.0	DE	NSTL			
7		5	UPSes	4.0	DR	RG/RB			
8		2	Enterprise Databases	3.0	DE	BN			
9		1	PowerPC NT Systems	3.5	DR	DR			
10		6	Symantec C++ 7	2.0	DE	Cole			
11		4	Visual Basic 4.0	2.0	DE	Gillmor			
12			HP Graphics Workstation	0.0	DR	Smith			dec
13		3	Ecco PIM	1.5	DE	Essex			
14			Current Page Count (of 20)	20.0					

Microsoft Office for Windows 95

The updated Microsoft Office suite delivers all the basic applications you'll need to become immediately productive in your new operating environment. The applications not only conform to Windows 95—32-bit architecture, multithreading (printing in Word, queries in Microsoft Access), consistent Win95 interface across all applications, long filenames, cross-application drag-and-drop, shortcuts (including creating shortcuts to a specific page in a Word document or a worksheet in Excel), and Briefcase support—but they also include new features worthy of version-number upgrades.

The most striking enhancement to the suite is the new Microsoft Office Binder.



● Phone
○ Handset

GETTING DIGITS

In Action: 9
Connected: 13

MaxDigits: 1 # of digit
DTermDigits: # Digits that will end collection
DigitsTimeOut: 15 # of seconds to wait for all digits
InterDigitTimeOut: 0 # of seconds allowed between digits

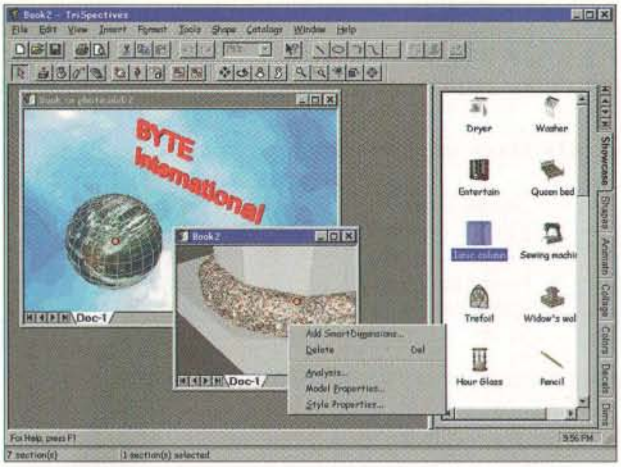
Visual Voice for Win32 enables more robust telephony applications under Windows 95, thanks to an integrated TAPI interface, multithreading, support for more telephone lines, and unimodem drivers.

The Binder is an enhanced OLE 2 container that lets you keep related documents within a single file structure. You can organize a project's electronic files within a binder, much as you would organize paper within a three-ring binder. Each section of the binder can contain a different file type (a Word document, a PowerPoint presentation, or any other file format that is Binder—not just OLE 2—compatible). You can then reorganize the sections by dragging the section icons (see the screen), dragging a section into another binder, adding an existing file to the mix, or printing all the documents in a binder using consecutive page numbering. Application vendors are already joining the Binder bandwagon, including Visio, Micrografx, and 3D/EYE.

If you already use Office, there is no learning curve, accept when dabbling in new features like the Binder. Given the remarkable market penetration of Microsoft Office, the jump it now has on the competition in supporting Win95, and third-party Binder support, Office 95 is clearly the suite to beat.

32-bit OLE Custom Controls

Microsoft's promise of an open, standard interface for reusable object components will finally blossom under Windows 95. Microsoft has announced that all its development tools will support 32-bit OLE controls across Windows 95 and NT, and it's worked hard to ensure a healthy component market with such incentives as Custom Control Wizards and extensive developer support. Soon an explosion of OLE controls is sure to hit the market, delivering reusable components for telephony,



TriSpectives Professional offers easy-to-use, sophisticated features. From the tabbed catalog on the right of the screen, you can drag objects onto either 3-D scene on the left. Right-click on an object to bring up tabbed dialog boxes for model properties and style properties.

imaging, communications, and other add-on functionality.

Long at the forefront of component technology, Stylus Innovation has announced its 32-bit OLE implementation of Visual Voice. Visual Voice for Win32 provides the developer with interfaces for recording and playing voice files, sending and receiving faxes, prompting for dial-pad input and processing the touch tones, answering and placing calls, and integrating with PBXes and multiline telephony boards. Visual Voice enables a wide variety of telephony-based applications, including fax-on-demand, Interactive Voice Response, and multilayered voice mail.

Windows 95 will greatly extend the capabilities of Visual Voice applications. The new OS will ship with native TAPI support, unimodem drivers, and multithreaded telephony services.

TriSpectives Professional

If you're looking for brand new software that deserves the killer-app label, check out TriSpectives Professional. It combines 3-D modeling, 3-D illustration, and 3-D animation with the drag-and-drop template model of Visio. TriSpectives implements OLE 2 from the ground up, is fully compatible with the Microsoft Office Binder, and relies on the improved performance of the Windows 95 graphics architecture.

You start with a 3-D scene (or a 3-D page) and a multitabbed catalog (see the screen above). You can select objects from any of the catalogs and drop them onto the scene. You can then drop colors or surfaces onto the object or rotate the object freely in 3-D space. Right-click on the object, and you get a tabbed dialog box for changing the object's properties: Give it a shinier finish, reflect a bit-map image off it, or add a decal of your choosing. Once you've created a model, you can drag and drop animation effects onto it (e.g., Y-move, Z-move, Fly In, or Grow) and access motion properties with a right-click.

The TriSpectives workspace acts as an OLE 2 container, and all the catalog items are independent OLE 2 objects. You can drag OLE objects—such as an Excel chart—from other applications and drop them into a 3-D scene or into a TriSpectives catalog. Once you've devised your own models, you can drag them into a catalog for future use or export them to other modeling formats (including exporting them as Visual Basic text files to generate code for creating models in Visual Basic).

Feature for feature, TriSpectives stacks up well against some high-end 3-D packages like 3D Studio, but its broader appeal stems from the ease-of-use features. It may help move 3-D illustration into the mainstream, enabling nonengineers to incorporate 3-D logos and animation effects into business presentations or product brochures.

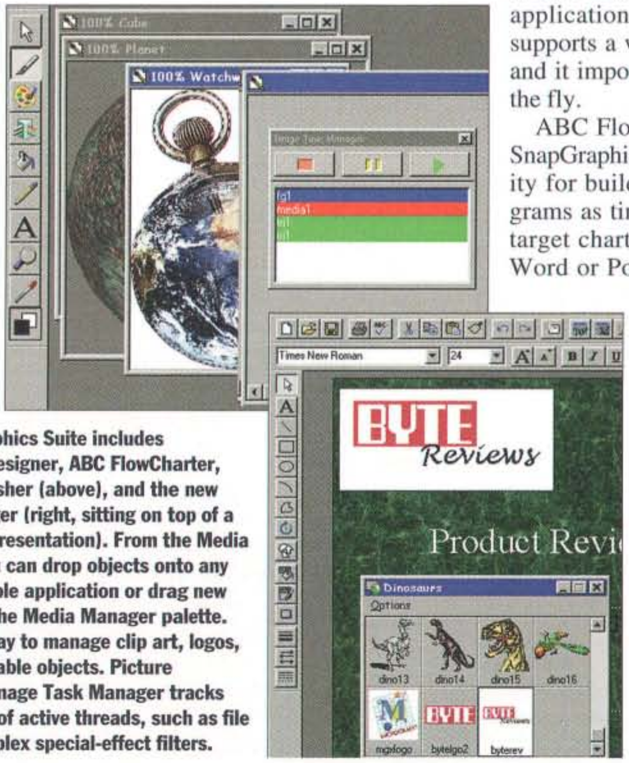
ABC Graphics Suite

Micrografx is the latest software vendor to become possessed by value-bundle mania. The company is packaging Micrografx Designer, ABC FlowCharter, Picture Publisher, and a new media-manager utility as an integrated suite and marketing it as an ideal companion product for Microsoft Office. The applications now conform to the Office 95 interface (as with all the Office 95 applications, only the application-specific menu item is unique), and all but FlowCharter are compatible with the Office Binder.

The applications are all 32-bit, and they fully support the Windows 95 interface. The Media Manager is an OLE 2 container for holding libraries of clip-art images and symbols. In fact, ABC FlowCharter uses the Media Manager as its symbol palette. You drag symbols from the palette and drop them into your flow charts, just as you can drop Media Manager clips into any OLE-compatible application. You can also drag any image (e.g., the company logo or a bit-map signature file) onto the Media Manager for use in other applications. The Media Manager supports a wide variety of formats, and it imports and exports them on the fly.

ABC FlowCharter now includes SnapGraphics, a template-based utility for building such business diagrams as time lines, pyramids, and target charts. Drop a diagram into Word or PowerPoint and edit it in place. FlowCharter incorporates OLE 2 automation, so you can build custom applications or use FlowCharter objects in any application that supports Visual Basic.

Of all the new applications we've seen so far, Picture Publisher has the best Windows 95 implementation of multithreading. Time-intensive processes like loading files or applying special-effect filters get



The ABC Graphics Suite includes Micrografx Designer, ABC FlowCharter, Picture Publisher (above), and the new Media Manager (right, sitting on top of a PowerPoint presentation). From the Media Manager, you can drop objects onto any OLE-compatible application or drag new objects into the Media Manager palette. It's a great way to manage clip art, logos, or other reusable objects. Picture Publisher's Image Task Manager tracks the progress of active threads, such as file loads or complex special-effect filters.

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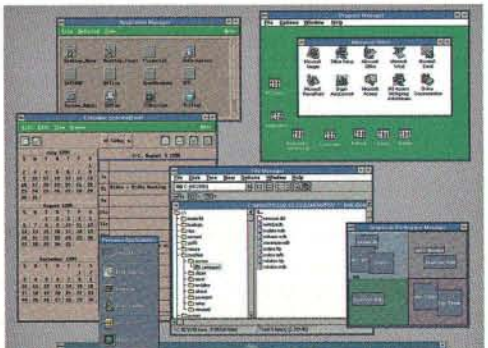

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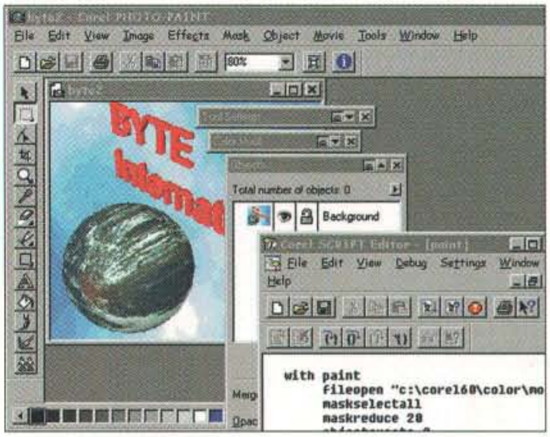
Corel PHOTO-PAINT
File Edit View Image Effects Mask Object Movie Tools Window Help
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Corel SCRIPT Editor - [paint]
File Edit View Debug Settings Window Help
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with paint
     fileopen "c:\corel60\color\mo
     maskselectall
     maskreduce 20
```

CorelDraw 6 includes four integrated applications, nine utilities, and a boatload of Corel extras. Shown is Photo-Paint with its roll-up dialog boxes and object palette for tracking objects in the active image. CorelScript is an OLE automation script editor and debugger.

their own thread. The Image Task Manager (see the screen on page 118) tracks the progress of each thread as you go about your work. The architecture showed up first in Picture Publisher for NT but could not be deployed under Windows 3.1. With elegant floating (and dockable) toolbars and intelligent interface design, Picture Publisher and Micrografx Designer meld smoothly into an Office 95 environment.

CorelDraw 6

Corel has always been the Swiss Army knife for Windows-based graphics design. Corel 6 bundles four integrated applications—CorelDraw, Corel Photo-Paint, Corel Presents, and CorelDream 3D (Corel has pulled Ventura from the bundle and will release a new version of the desktop publisher in November). All of the applications sport a 32-bit multithreaded architecture and conform fully to the Win95 interface: long filenames, uninstall modules, wizards, extensive right-mouse-button shortcuts, tabbed dialogs and property sheets, dockable toolbars, and rich OLE 2 functionality (in-place editing, drag-and-drop across applications, and OLE automation through CorelScript). The Corel suite goes a step further, enhancing the interface with dialog roll-ups, an excellent desktop-saving feature (see the screen above).

As always, the package includes utilities (a 3-D logo creator, a multimedia file manager, font management, an OLE 2 scripting language, a dialog editor, and four other utilities) and a gaggle of extras (e.g., 25,000 clip-art images, over 1000 fonts, photos, templates, 3-D models, sounds, objects, animation actors, and backgrounds). Windows 95 may solve one common complaint about Corel: its nonstandard interface. The bundle finally comes together nicely, delivering an integrated solution to Windows-based designers and illustrators.

The Gaming Platform

No bones about it: Microsoft wants Windows 95 to be a killer games platform. As a gaming environment, Windows 3.1 was a big, fat flop. Hard-core PC gamers are still firmly planted in DOS. But the Windows 95 architecture will change all that. Early betas of new games clearly portend a thriving Win95 games market.

Pitfall: The Mayan Adventure (below, right), is an arcade-style adventure game from Activision that has been hugely popular on Nintendo and other gaming systems. Pitfall now works like a charm under Windows 95. It is exactly the kind of game that once required DOS to run effectively. There's lots of fast motion, real-time interactive responses, and intensive graphics. Under Windows' old Graphical Device Interface (GDI) architecture, this level of responsiveness was not possible, but the Win95 DIBEngine lets game developers blast device-independent bit maps (DIBs) directly to the screen. Confirming its faith in the Win95 game market, Activision plans to release eight Windows 95 games by the end of the year and will no longer develop for the MS-DOS platform.

> **As a gaming environment, Windows 3.1 was a big, fat flop.**

Educational titles should also prosper. The Freddi Fish title (shown below, left) uses auto-run (a Win95 feature that automatically plays a CD-ROM when it is loaded) to avoid installation hassles altogether. You load the CD, and a splash screen pops up automatically. Click on the play button, and the game starts. With auto-run, Freddi Fish implements a "zero-footprint" design, moving files to the hard disk as needed and then removing them when the game exits. The graphics are sharp and colorful, the animation smooth.

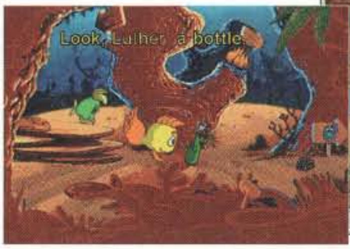
An impending upgrade to Display Control Interface (DCI) will further enhance Win95 as a gaming platform, adding automatic support for multiuser games, MIDI sound, and digital joysticks.

Windows 95 Componentware

Componentware—small applets that deliver focused functionality to desktop applications—has been a hot topic, and an expected trend, for some time now. And yet fatware continues to thrive. Again, the clunky mechanism of OLE 1 and DDE under Windows 3.1 must assume part of the blame. Now, with its full integration of OLE 2 and OLE Automation, Windows 95 delivers an environment that will support robust component utilities. Some early announcements prove the viability of component technology; it's now up to the market to determine the success of the componentware design philosophy.

Alphablox, a new company derived from Alpha Software, is shipping a set of five utilities, called Officeblox, that adhere to the componentware model. With Noteblox, you can post sticky notes onto

The new DIBEngine graphics architecture in Windows 95 should spurn a thriving games market that has long eluded Windows. Game developers can now bypass GDI and blast device-independent bit maps directly to screen. This architecture enables fast-paced arcade-style games like Pitfall (far right) and educational titles like Freddi Fish (right) to run smoothly under Windows 95.



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TECHNOLOGY FOCUS

OLE Structured Storage

The OLE 2 architecture and, specifically, OLE's Structured Storage model enable many of the most powerful features gracing the new wave of Windows 95 applications. The Office Binder, the "stencil" metaphor of both Visio and TriSpectives, and the componentware market all depend on the Windows 95 implementation of Structured Storage.

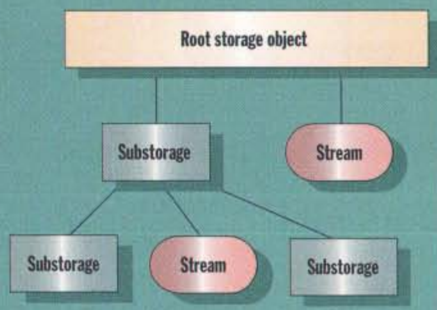
Application developers are accustomed to assigning file handles and reserving files for a single application, but compound documents allow many applications to write to a single file. Without an OS-level mechanism for handling compound files, the developer must keep track of multiple seek pointers and, in effect, build an internal file system.

A Structured Storage implementation solves the problem of compound files by supporting a file system within a file. OLE 2 specifies a file structure that can contain two distinct types of objects—storage objects and stream objects. Streams hold data (such as the text in a Word file), while storage objects can hold within them any number of substorage objects or streams. Substorage objects (like subdirectories of a root directory) can, in turn, hold other substorages or streams. Each of these object types expose interfaces (in this context, an interface is an array of functions that other objects or applications can call).

Structured Storage frees an OLE container application from managing its own file structure. Instead, the OLE container provides a storage object to any compound document (or other embedded object) that it hosts. The object then manages the streams and substorages under its control. The application container no longer has to manage the complexity of multiple file pointers. In fact, the application doesn't have to do any work at all. The storage object writes directly into the piece of storage under its control without any interaction with the container itself.

OLE Structured Storage also makes data exchange more robust. Under OLE 1, data was transferred through DDE's mechanism of global memory. OLE 2 applications simply pass a pointer to a data object from the source application to the data recipient. This mechanism is implemented through the OLE 2 interfaces to storages and streams. Future versions of NT (Cairo) will use Structured Storage as its native file system.

Compound File Model



To support compound files, OLE implements a file system within a file.

any application or directly onto the Windows 95 desktop. Embed Calcblox into an application to enable quick calculations at the click of a button. Listblox lets you jot down to-do items, generate a quick expense report, or embed a simple list manager into your word processor.

Toolblox is the most interesting component. You can launch applications from the toolbar or drag objects (applications, documents, images—i.e., any OLE object) onto it. You can even specify an application's exposed objects as a Toolblox item; for instance, when you drag the Excel icon onto the toolbar and edit the entry, a list box displays Excel's components. You can then select the Excel's calculation engine or its charting module as the launchable component. The toolbar's template icon brings up a wide variety of Officeblox templates for quickly creating agendas, phone messages, meeting requests, or other memos.

Workblox will ship as a "trial" application in Officeblox. Workblox, a tabbed OLE 2 container, gives you a convenient place to store objects or catalog your work.

The Applications Cometh

When all is said and done, Windows 95 won't require a few killer apps to succeed. It is the shear breadth of supported applications that drives the popularity of the Windows platform. But a wave of significant upgrades and new product announcements can only help fuel the acceptance of Windows 95 across the enterprise and in the home. ■

Product Information

ABC Graphics Suite $495
Micrografx, Inc.
Richardson, TX
(214) 234-1759
http://www.micrografx.com
Circle 1066 on Inquiry Card.

CorelDraw 6 .... $695
Corel Corp.
Ottawa, Ontario
(613) 728-8200
fax: (613) 761-9176
Circle 1067 on Inquiry Card.

Freddi Fish $39
Humongous Entertainment
Woodinville, WA
(206) 486-9258
fax: (206) 486-9694
http://www.humongous.com
Circle 1068 on Inquiry Card.

OfficeBlox $69
AlphaBlox Software Corp.
Burlington, MA
(617) 229-2924
fax: (617) 272-4876
Circle 1069 on Inquiry Card.

Pitfall: The Mayan Adventure ... $49
Activision
Los Angeles, CA
(310) 473-9200
fax: (310) 479-4005
http://www.activision.com
Circle 1070 on Inquiry Card.

TriSpectives Professional $499
3D/Eye
Ithaca, NY
(607) 257-1381
fax: (607) 257-7335
http://www.eye.com
Circle 1071 on Inquiry Card.

Visio 4.0 .... $249
Visio Corp.
Seattle, WA
(206) 521-4500
fax: (206) 521-4501
Circle 1072 on Inquiry Card.

Visual Voice for Win32 (2 lines) $495
unlimited lines $2995
Stylus Innovation
Cambridge, MA
(617) 621-9545
fax: (617) 621-7862
info@stylus.com or
http://www.stylus.com
Circle 1073 on Inquiry Card.

Windows 95 ... $209; upgrade, $109
Microsoft Office for Windows 95 .. $499
Microsoft Corp.
Redmond, WA
(206) 882-8080
fax: (206) 936-7329
http://www.microsoft.com
Circle 1074 on Inquiry Card.

Stanford Diehl, director of BYTE product reviews, has been evaluating computer products for over 10 years. He holds degrees in English literature, computer science, and electronics technology. You can reach him on the Internet or BIX at sdiehl@bix.com.

Power Mac Gets PCI

The 9500 sports a top-of-the-line PowerPC 604 CPU and PCI bus, too

TOM THOMPSON

With the latest PowerPC 604 processor and a retooled I/O system, Apple's new Power Mac 9500 delivers great performance. Using the industry-standard PCI expansion bus, the latest Power Macs should spawn a wide selection of fast, lower cost Mac/PCI peripherals. Most important, the 9500 maintains software compatibility despite big I/O system changes.

The Power Mac 9500 comes in 120-MHz and 132-MHz versions: the 9500/120 and the 9500/132, respectively. Base RAM starts at 16 MB (expandable to 768 MB) with a 512-KB secondary RAM cache. Standard features include six PCI-bus slots, a 1- or 2-GB Fast SCSI drive, a quad-speed CD-ROM drive, two GeoPort serial ports, and two Ethernet ports (10Base-T and AUI). An internal bus supports SCSI-2 fast transfers, while the external SCSI bus (standard Macintosh DB-25) handles slower external devices.

Next-Generation Design

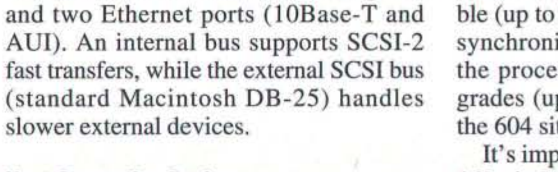
Apple created a second-generation architecture for the 604. First, there's that industry-standard, 33-MHz PCI expansion bus (see "Inside the PCI Local Bus," February 1994 BYTE). Most internal I/O subsystems use Open Firmware and the PCI bus for start-up configuration and data transactions. Currently, Open Firmware isn't required for PCI card firmware to operate on the 9500 except with boot devices (such as display or network cards). The system also uses Open Transport, a Unix network standard, to implement its network interface and protocol stacks.

The 9500's memory subsystem is 16 to 20 percent faster than those of previous designs. Memory interleaving generates 128-bit-wide memory accesses. The memory controller is smarter about accesses as well; it monitors memory paging to reduce virtual memory overhead and uses DMA for block transfers. It also snoops memory accesses and can thus cache such previously uncachable transfers as I/O and video frame buffers. Finally, copy-back caching algorithms reduce bus traffic.

The memory bus speed is programmable (up to 50 MHz), which enables better synchronization of RAM accesses with the processor bus and allows CPU upgrades (up to a 150-MHz 604), because the 604 sits on a plug-in daughtercard.

It's important to note that the 9500 uses 168-pin JEDEC dual in-line memory modules (DIMMs) instead of the 72-pin SIMMs found in existing Power Macs. If you step up to a Power Mac from an older system with lots of memory, you have two options: You can pony up lots of cash for new DIMM memory, or you can use Newer Technology's DIMM Tree ($69; (800) 678-3726), a slick little gizmo that plugs into the 9500's DIMM sockets and provides SIMM sockets for your old RAM (provided it's 70-nanosecond or faster).

PowerPC Surpasses Speediest Pentium



Running BYTE's Native Performance Benchmark at similar clock speeds, the PowerPC 604's integer performance is 87 percent faster than that of a 133-MHz Pentium machine, and floating-point performance is 72 percent faster. We used Motorola's latest PowerPC libraries to compile the test.

Hard disk I/O has been a Power Mac bottleneck, but the 9500 fixes that with native code for the SCSI driver instead of 680x0 code. (However, file system software is still 680x0 code that undergoes emulation.) Last, the SCSI and other I/O subsystems use a descriptor-based DMA control that minimizes CPU involvement (see "Smarter DMA" on page 124).

The 9500 ships with a tuned up OS, System 7.5.2. Its faster 680x0 emulator uses dynamic recompilation (see "Building the Better Virtual CPU," August BYTE). Other OS optimizations include more native code (such as in the SCSI Manager), some device drivers, and network protocol stacks. Existing native portions of the OS, such as QuickDraw, the math library, and Memory Manager, are tuned for the 603 and 604.

CRAIG ALNESS © 1995

The Apple of your dreams: a 132-MHz 604-based Power Mac.

Trial Run

We tested a Power Mac 9500/132 with 32 MB of RAM, a 2-GB hard drive, and ATI's Mac-adapted PCI display card. The ATI card uses QuickDraw's new acceleration API, which makes for snappy screen drawing. With the 604, the Power Mac pulls substantially ahead of similar-speed Pentium systems in both integer and floating-point performance, thanks to a faster CPU and compiler improvements (see the figure "PowerPC Surpasses Speediest Pentium"). An improved compiler enhances a system's performance in our native-mode benchmarks, just as it will enhance application speed.

Product Information

Power Mac 9500
with a 132-MHz 604,
16 MB of RAM, and a 2-GB
hard drive $5799
with a 120-MHz 604,
16 MB of RAM, and a 1-GB
hard drive $4999
Apple Computer, Inc.
Cupertino, CA
(800) 776-2333
(408) 996-1010
fax: (408) 974-6412
Circle 1065 on Inquiry Card.

Low-level 680x0 tests show that the 9500 memory subsystem is several times faster than that of a 110-MHz 601-based Power Mac. On application tests, disk I/O was also noticeably faster. Considering the complete overhaul of the Power Mac bus and network interface, there are surprisingly few incompatibilities. The usual

TECHNOLOGY FOCUS

Smarter DMA

By handling memory transfers for the CPU, a good direct memory access (DMA) system improves overall performance. Still, moving large blocks of data between memory and a device, or vice versa, requires multiple DMA transfers. Typically, each transfer ends in an interrupt to the CPU, which must then drop what it's doing to set up the next transfer. To manage its 14 DMA channels without this overhead, the 9500 employs a descriptor-based DMA engine.

Descriptors serve as a simple instruction set for implementing DMA transfers. Glue logic around the DMA controller executes the instruction set, which supports branching, looping, and error handling. Each descriptor is a four-long-word data block with 16- and 32-bit fields that include the command, requested data size, buffer address, a device-specific instruction, status, information, and the resulting amount of data moved. Not all commands use all fields. By chaining descriptors into a mini-program, descriptor-based DMA moves large data blocks without interrupting the CPU.

Taking advantage of descriptor-based DMA requires device-driver modification. The driver must parse each I/O request for size and location and then place in memory sufficient descriptors to handle the transfer. SCSI, Ethernet, sound, serial, and floppy subsystems use this capability to reduce CPU overhead in the 9500.

16	16
command	reqCount
address	
cmdDep	
xferStatus	resCount

By chaining DMA descriptors to describe and execute DMA transfers, the 9500 reduces CPU overhead.

assortment of applications, Control Panels, and Extensions—both native and 680x0—functioned as they should. Lotus's cc:Mail worked over the network connection with just one nonreproducible glitch.

We experienced troubles with downloads using Aladdin's SITcomm terminal program. When a noisy connection caused this normally reliable program to abort a ZMODEM transfer, it failed to recover. We also discovered that an old SCSI tape drive would hang the system unless we switched on the drive after the 9500 booted.

It's now too soon to tell how well the first Mac-compatible PCI cards will work. Companies such as Rockwell (FDDI network card) and Diamond Multimedia (accelerated display card) should have products shipping by the time you read this.

Despite some teething pains, the 9500 provides plenty of horsepower for those who need it. You can expect vendors to correct problems and revise applications to make best use of the 604 processor. In addition, PCI peripherals will cost less and give you higher performance. ■

Tom Thompson is a BYTE senior technical editor at large with a B.S.E.E. from the University of Memphis. He is also an Associate Apple Developer. You can reach him on AppleLink as T.THOMPSON or on the Internet or BIX at tom_thompson@bix.com.

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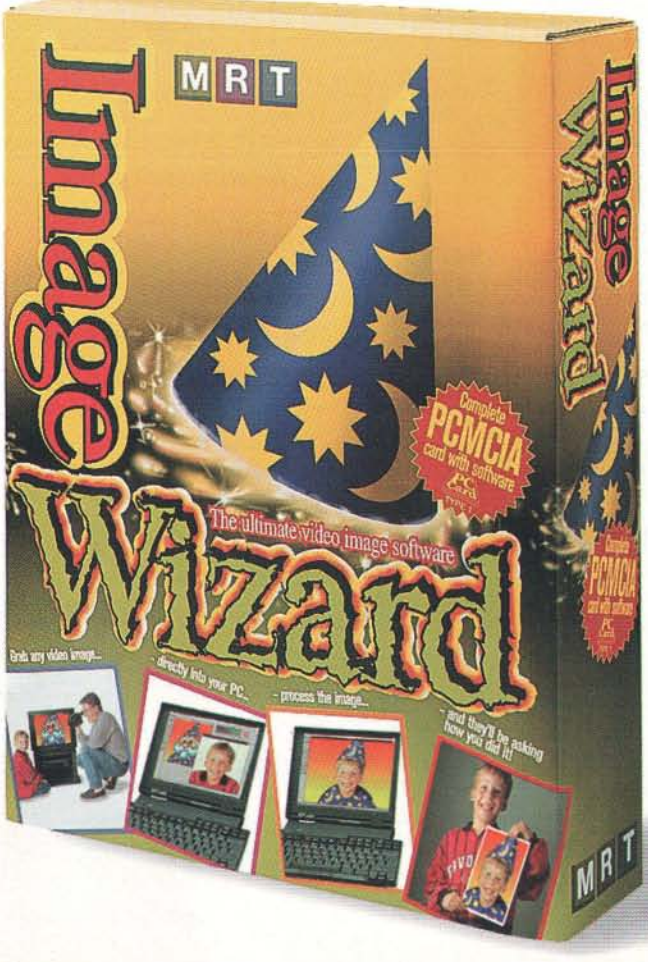
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Au Revoir, Mon Ami

Word Pro, formerly Lotus Ami Pro, touts innovative features, but they may not be enough to convert Microsoft and Novell users

KENNETH M. SHELDON

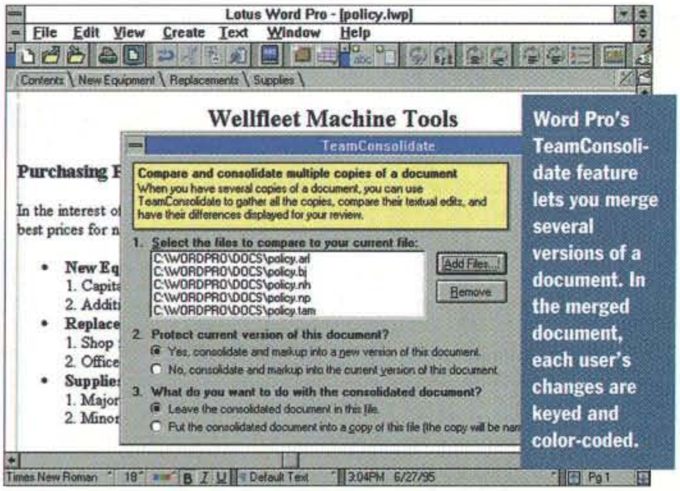
When Ami Pro first arrived on the scene, it was the leader among Windows word processors, thanks to such innovative features as WYSIWYG and style sheets. But it hasn't seen a major revision since July 1992, and its competitors—notably Microsoft Word for Windows and Novell's WordPerfect for Windows—have passed it in both power and popularity.

Still, die-hard believers have stuck with Ami Pro, hoping for a competitive upgrade. Finally, the faithful have been rewarded with so many new features that Lotus decided to give Ami Pro a new, if less original, name: Word Pro.

The Team Approach

The most significant new features in Word Pro stem from Lotus's cross-application team-computing effort. Among these features are TeamReview and TeamConsolidate, which allows you to share documents with other people—each of whom can make edits and revisions—and then consolidate the changes into a final document.

The TeamReview Assistant feature enables you to specify who reviews a document, what kinds of changes are allowed, and through what medium the document is to be routed. Team members can make changes, highlight text, and add comments (including text, graphics, and even sound and video clips).



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TeamConsolidate

Compare and consolidate multiple copies of a document
When you have several copies of a document, you can use TeamConsolidate to gather all the copies, compare their textual edits, and have their differences displayed for your review.

1. Select the files to compare to your current file:
   C:\WORDPRO\DOCS\policy.arl
   C:\WORDPRO\DOCS\policy.bj
   C:\WORDPRO\DOCS\policy.nh
   C:\WORDPRO\DOCS\policy.np
   C:\WORDPRO\DOCS\policy.tam
2. Protect current version of this document?
   ● Yes, consolidate and markup into a new version of this document.
   ○ No, consolidate and markup into the current version of this document.
3. What do you want to do with the consolidated document?
   ● Leave the consolidated document in this file.
   ○ Put the consolidated document into a copy of this file (the copy will be nam

Word Pro's TeamConsolidate feature lets you merge several versions of a document. In the merged document, each user's changes are keyed and color-coded.

Using TeamConsolidate (see the screen above), you can then merge all the changes and comments—all keyed and color-coded for each team member—into a single document. Word Pro's version control lets you maintain several versions of a document in a single file (see the Technology Focus box at left for more details).

Lotus's team-computing philosophy is also evident in a feature called Notes/FX. This component allows Lotus Notes users to integrate Notes databases with Word Pro to create customized applications and documents.

Some Things Borrowed

Word Pro has adopted some slick features from other applications. For instance, divider tabs let you jump quickly to a specific section of your document. You can also link a divider tab to an external document or an OLE file.

Another borrowed feature, the InfoBox, originated in Lotus Improv and is now common across the Lotus SmartSuite applications. The InfoBox places all the editing and formatting tools for objects such as text and frames in a standardized, context-sensitive box.

The spelling checker, much improved, now supports interactive spell-checking as you edit. When you invoke Spell Check, it automatically highlights all the misspelled words in a document. You can quickly scan the document for true mis-

TECHNOLOGY FOCUS

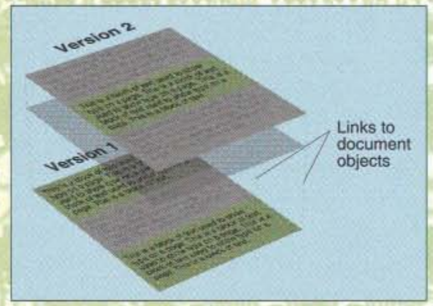
Object-Based Version Control: The Big Difference

Word Pro's version-control features rival the tools found in software development and document management programs. For example, the first time you save a document, Word Pro stores everything in a single read-only file. As you make and save changes, Word Pro saves only the changed portions of the original. A searchable history of the document is always available, and disk space is conserved.

To manage such changes, Word Pro turns major document elements into objects, which are then tracked in a coded list embedded in the file. Users can't view the list, although they can see an editable directory of versions. Versions share objects, including document properties, embedded or linked objects, OLE objects, equations, and charting objects.

A shared object is, in effect, externally linked to all file versions. For example, if you create a chart in a Word Pro document and then update it in a second version of the file, the second version does not contain a full copy of the chart. Instead, the copy is maintained in the original version and linked to the new portions in subsequent versions. When you change data, the original chart is modified, and all links are updated.

Reused objects must be maintained in a read-only state to avoid ripple effects in later versions. For getting around this limitation, Word Pro lets you cut and paste previous versions of a document into a new one. You can also save versions in separate disk files.



Versions of a document are pieced together from linked objects containing the most recently modified elements.

takes and edit them without deactivating the Spell Check dialog box.

Lotus has replaced the macro facility in Ami Pro with LotusScript, an object-oriented, cross-application scripting language that will eventually work across the entire suite of Lotus products. Unfortunately, you can't use it to run a macro from a keyboard combination. However, you can save scripts as external files or attach them to particular SmartMasters, the successors to Ami Pro's style sheets.

And, with Word Pro's script editor, you can link scripts to specific events, such as opening a document or clicking on a frame. Lotus says that Word Pro will run many Ami Pro macros. Given Microsoft's support of Visual Basic for Applications and WordPerfect's cross-application scripting, Lotus will certainly have a hard time differentiating its product line with LotusScript.

Playing Catch-Up

Some of Word Pro's features simply bring it up to speed with its competitors. SmartCorrect, for example, corrects typos on the fly and lets you add words that your fingers commonly mistype. Multilevel undo now lets you undo nearly any change that you've made to a document, and the automatic timed-save feature now saves untitled documents.

As for performance, we found a late beta version of Word Pro poky running on a 66-MHz 486 (see the table "Measured Words"). Word Pro will not score any points for performance.

However, dedicated Ami Pro aficionados will like Word Pro. It adds plenty of new features and improvements while retaining a comforting familiarity. In addition, those who perform their computing tasks in groups—especially users of Notes, 1-2-3, and other Lotus applications—will undoubtedly welcome Word Pro's improved integration with those programs.

Product Information

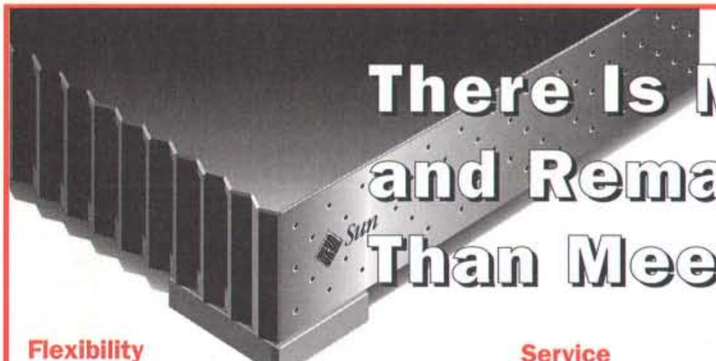
Lotus Word Pro $105
(estimated retail price)
Lotus Development Corp.
Atlanta, GA
(800) 343-5414
(404) 391-0011
http://www.lotus.com/
Circle 1030 on Inquiry Card.

MEASURED WORDS

	OPEN AND CONVERT 10-KB FILE (IN SECONDS)	FILE SIZE AFTER CONVERSION (IN KB)
Lotus Word Pro	8	19
Microsoft Word	1	18
Novell WordPerfect	1	11

Word Pro's chances in the overall word processing race are less certain. While features like TeamReview and TeamConsolidate are more powerful and easier to use than anything found in pre–Windows 95 versions of Word and Word Perfect, a number of Word Pro's flashiest features are merely different—not necessarily better—ways of doing things. Word Pro is good enough to hold on to its believers, but it may not be innovative enough to woo a new generation of converts. ■

Kenneth M. Sheldon is a freelance journalist and a former BYTE West Coast bureau chief. You can contact him on the Internet or BIX at ksheldon@bix.com.



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Digital Cameras for Real Work

New sub-$1000 digital cameras strike a practical balance between price and image quality

ALAN MORGAN AND SCOTT WALLACE

The benefits of digital photography—filmless cameras that feed images directly to your computer—have always been obvious, especially for field work such as insurance and real estate applications. The high cost of this new technology has been just as obvious. But now affordable digital cameras, priced just under $1000, support new ways of using digital images in business, scientific, and publishing applications. Though they can't rival scanners in resolution or fidelity, they dramatically improve ease of use and reduce production time.

The trio of cameras reviewed here—from Apple, Kodak, and Logitech—are based on the same Kodak core. These 24-bit cameras are similar in form and function but differentiate themselves in storage capacity, operator controls, and approach to image processing. Casio's new QV-10 is a different breed altogether (see "Casio's QV-10: Portable Presentations" below), and suggests the direction future digital cameras may follow.

The three Kodak-based cameras all share the lightweight feel of a point-and-shoot film camera, including built-in flash and removable batteries. The Kodak and Logitech cameras can also take some third-party lenses. All three store image data in EPROM flash memory, which retains images even when batteries go dead.

CRAIG ALNESS © 1995

Three digital cameras from Apple (top), Kodak (right), and Logitech (left) are all based on a Kodak core product. The Apple has the lowest price ($739) and works with both Macintosh and Windows PC platforms.

The bundled Macintosh or Windows software supports simple image manipulation as well as several compression protocols, such as JPEG and TIFF, for migration to professional-quality applications.

Price still limits image resolution, but increasingly sophisticated processing makes relatively low-resolution data more realistic (see "Imaging Without Film" on page 130). Though they still don't deliver the vibrancy and sharpness of film-based cameras, the new Kodak-based cameras provide significantly better quality than less expensive digital cameras.

Kodak's DC40

Like Logitech's FotoMan Pixtura, Kodak's DC40 (Digital Camera 40) offers more storage capacity than Apple's QuickTake (4 MB versus 1 MB) and higher image

Casio's QV-10: Portable Presentations

While Kodak's DC40 and Logitech's Pixtura produce the best printed picture and Apple's QuickTake 150 has the best monitor display, Casio's new QV-10 stakes out NTSC video as its forte. Due this summer, Casio's entry into the digital camera market provides numerous design innovations that could steer things toward smarter, friendlier image capturing.

The 1.8-inch-square active-matrix color LCD viewfinder on the camera's back says that the QV-10 is not the standard point-and-shoot film box it resembles. Its through-the-lens view frames an object without parallax and brings WYSIWYG to the under-$1000 camera field. You can adjust contrast and framing before taking the picture. Also, you can tilt the lens up or down, switch it to a macro for close-ups, and adjust the LCD's optimal viewing angle. Thus, it's easy to shoot with the camera placed in any convenient location.

The same LCD lets you review all 96 pictures, which you can store in the QV-10's 2-MB flash EPROM. To make comparison easier, the LCD can display four or nine pictures at once (and the images remain recognizable). You can also zoom in on a portion of an image for detail. You can delete any picture in memory, and the remaining shots renumber to make room for more. (In contrast, the Kodak family lets you delete only the latest image, and enabling the delete-last-picture option can reduce storage capacity by 30 percent.)

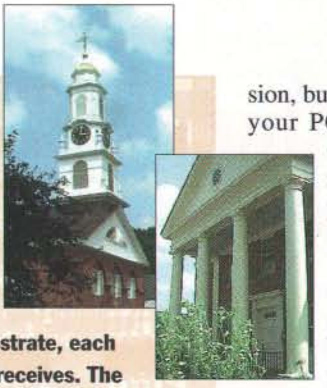
The camera's weak point is that it captures images at a resolution of only 480 by 240 pixels. All output from the camera is converted to 320 by 240 pixels (or interpolated up to 640 by 480 pixels) so print and VGA output will likely be acceptable only in small sizes. But on a TV or videotape, the image works well.

What will sell the QV-10 is its in-camera presentation abilities. Images are stored digitally but can be retrieved as either digital or NTSC video signals. In "autoplay" mode, the QV-10 displays stored images sequentially at a selected rate. Even better, you can download images from your PC. You can upload images from the camera to a PC, add graphics and lettering, reorder everything, and then download a presentation back to the camera. Hook the QV-10 to a TV, turn on autoplay, and watch the show. It can loop endlessly, including four- and nine-image screen displays, making catchy advertising for store windows or sales booths.

DIGITAL PHOTOGRAPHY: BARBARA BUSENBARK © 1995

TECHNOLOGY FOCUS

Imaging Without Film

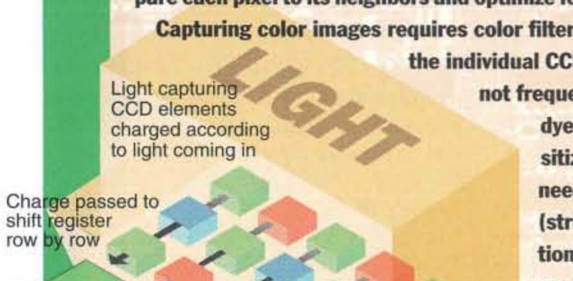


The CCD (charge-coupled device) that converts light to electric charge in today's digital cameras traces its ancestry back to the first black-and-white camcorders. A camera CCD is a single silicon chip that combines a rectangular array of light-sensitive cells with circuitry to process and digitize the image the cells record.

As the camera's shutter exposes the CCD's imaging substrate, each cell builds a charge proportional to the amount of light it receives. The resulting image is read cell-by-cell using a bucket-brigade process that takes 4 to 5 seconds with these cameras. The cells in the bottom row pass their charges to a serial shift register below the array. Cells in the rows above pass their charges down one row.

Cell by cell, the CCD chip reads the contents of the shift register, converting the number of electrons to an amplified analog signal. Row by row, the analog signal is processed into a digital image that is stored in the camera's memory. During this transfer, information from the cells may be discarded or combined to reduce image file size and resolution. Even today's low-end digital cameras compare each pixel to its neighbors and optimize for contrast, hue, and saturation.

Capturing color images requires color filters (red, green, and blue) because the individual CCD cells measure light intensity, not frequency. The simplest technique dyes the surface of each cell to sensitize it to one of the three colors needed. After early missteps (striped arrays that reduced resolution by two-thirds), Kodak developed a checkerboard mosaic of colored pixels based on experience gained with film chemistry. The resulting Bayer Pattern CFA (color filter array) has more greens than reds and blues (see figure), since human visual systems perceive that ratio as "sharper."


LIGHT
Light capturing CCD elements charged according to light coming in
Charge passed to shift register row by row
Shift register
To A/D converter and output processing

resolution (768 by 512 pixels versus 640 by 480). After analyzing captured data with a "nearest neighbor" algorithm, all three cameras compress it with Kodak's proprietary RADC algorithm. RADC creates some edge artifacts but otherwise packs information into less memory with less quality loss than Kodak's older 80PCM algorithm (used in Apple's QuickTake 100).

Easy to set up, the DC40 combines plug and play with point and shoot. The controls are easy to use. The camera's four AA lithium batteries are good for about 500 pictures (depending on flash use and how many images you download to a PC) and support a 5-second cycle time between shots when fresh.

Storage capacity and resolution options are the primary differences between the three cameras. The Kodak camera takes 48 or 99 pictures, depending on compression, but you must make the choice from your PC when the camera is empty. Choose the higher compression rate only when you'll display the pictures very small or in gray scale.

The PC connection is quick—simply run the cable from your serial port to the camera. With the bundled PhotoEnhancer software, you can view stored images as slides and download them to your computer. The software lets you perform any of a simple menu of image manipulations with ease. A helpful preview feature displays nine variations of the image at once. Kodak released Mac software in July.

The Kodak and Logitech cameras offer you more control than the Apple, as you can alter exposure ±2EV on the fly. Telephoto and wide-angle lenses are available from such manufacturers as Tiffen to augment the built-in 42mm-equivalent lens.

Apple's QuickTake 150

Not surprising, Apple's QuickTake 150 works with both Windows-based PCs and Apple Macintosh computers. Both versions ($739) come with appropriate cables and bundled software; the Macintosh software provides more features.

Although the Kodak-manufactured QuickTake 150 looks similar to the DC40, Apple cut the price 25 percent partly by not using unnecessary CCD (charge-coupled device) pixels. Using only a 640- by 480-pixel matrix, the QuickTake matches the most common monitor resolution. Having 86,016 fewer pixels to process speeds up operations from capture through transfer to display, and saves disk space, too. Additional cost savings come from reduced storage memory, simpler controls, fewer batteries, and elimination of the lens mount. The resulting lighter camera feels less substantial than the DC40 or the Pixtura, but delivers comparable images.

The QuickTake's 1 MB of memory holds only 16 to 32 images, but you can mix different quality shots in the same session. For lower-quality shots, both Apple and Kodak decided that compressing pixel data causes less "quality loss" than

Product Information

Digital Camera 40 . . . $995
Eastman Kodak Co.
Rochester, NY 14650
(800) 235-6325
(716) 724-4000
http://www.kodak.com
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FotoMan Pixtura $995
Logitech, Inc.
Fremont, CA
(800) 231-7717
(510) 795-8500
fax: (510) 792-8901
Circle 1062 on Inquiry Card.

QuickTake 150 . . . . $739
Apple Computer, Inc.
Cupertino, CA 95014
(800) 538-9696
(408) 996-1010
fax: (800) 462-4396
http://www.apple.com
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QV-10 . . . . $995
Casio, Inc.
Dover, NJ
(800) 962-2746
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fax: (201) 361-3819
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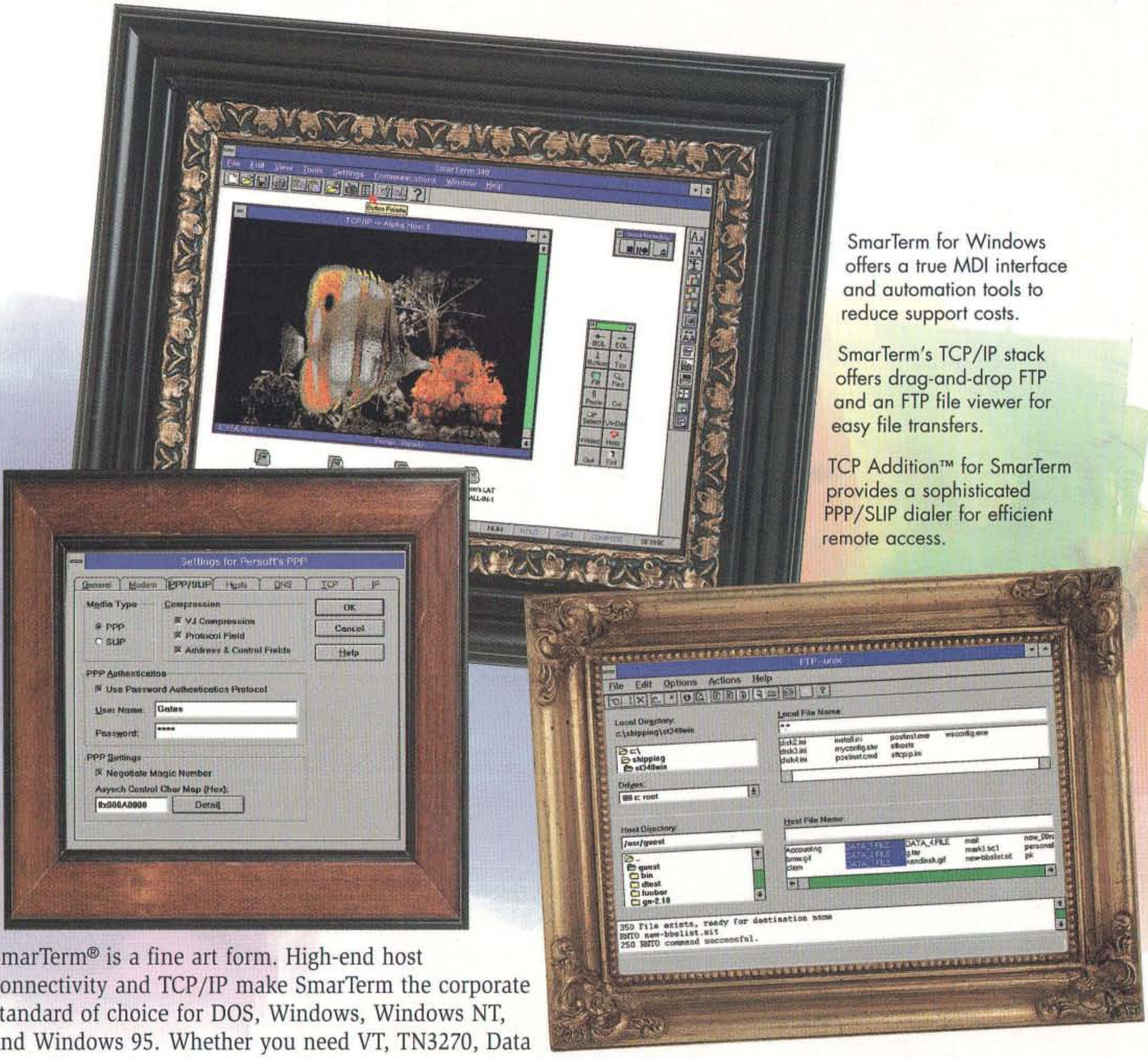
The Art of Smart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☒ Protocol Field
☒ Address & Control Fields

PPP Authentication
☒ Use Password Authentication Protocol
User Name: Gates
Password: ****

PPP Settings
☒ Negotiate Magic Number
Asynch Control Char Map (Hex): 0x000A0000

Local Directory: c:\shipping\st340win
Drives: c: root
Host Directory: /usr/guest

```
350 File exists, ready for destination name
RNTO new-bbslist.sit
250 RNTO command successful.
```

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sampling fewer pixels—the approach taken by most cameras, including the Pixtura.

Of the three, the QuickTake is the simplest to operate, with fewer display-panel options and controls that are easier to figure out. The cycle time of 4 seconds between shots is faster than that of the DC40. Three AA batteries support only 200 pictures, but an optional external battery pack with eight AA cells can take thousands.

The fixed 50mm-equivalent lens focuses from four feet to infinity, and a snap-on close-up adapter with flash diffuser allows pictures in the 10- to 14-inch range. A parallax-correction lens is included for the view finder, which, like the other cameras, is not WYSIWYG.

Logitech's FotoMan Pixtura

The FotoMan Pixtura and the DC40 cameras are identical in appearance and nearly identical in features. At its default resolution, however, the Pixtura holds 144 pictures in its 4-MB memory, more images than any of the tested cameras. Logitech achieves this by making "standard" resolution 384 by 256 pixels and "high" resolution 768 by 512 pixels, rather than using increased compression as Kodak and Apple do. A memory management quirk shared by the Pixtura and the DC40 is that if you enable the "delete last picture" option, it reduces the capacity for high-resolution images from 48 to 31.

The Pixtura's Digital Eyes software (from Day One) supports a function not included with the others. You can adjust the compression rate for exported JPEG format files on a continuous scale from minimum to maximum, which lets you reduce file size greatly if your application can stand the data loss.

Parting Shot

With improved resolution and image processing, these midrange digital cameras will increase use of digital photography in business and professional applications. We preferred the QuickTake's controls and price; at $739, it's $250 under the others. However, the DC40 and Pixtura have a hand strap, higher capacity, and the ability to take additional lenses. Overall, Apple's QuickTake 150 is still the best buy. ■

Alan Morgan, a programmer for 15 years, is a freelance writer and photographer who no longer looks down his nose at digital cameras. You can reach him at amorgan@equinox.ShaysNet.com. Scott Wallace is a former BYTE technical editor who can be reached at editors@bix.com.

Let's Get Small

Super-small and super-smart, new microcontroller development systems are changing the shape of embedded design

RICK GREHAN

Miniaturization has created a new twist in the world of embedded design: The development system is also the target system—you design on the system that you deploy. Your PC becomes the development host and is tethered to the target via a serial cable or a specialized parallel cable.

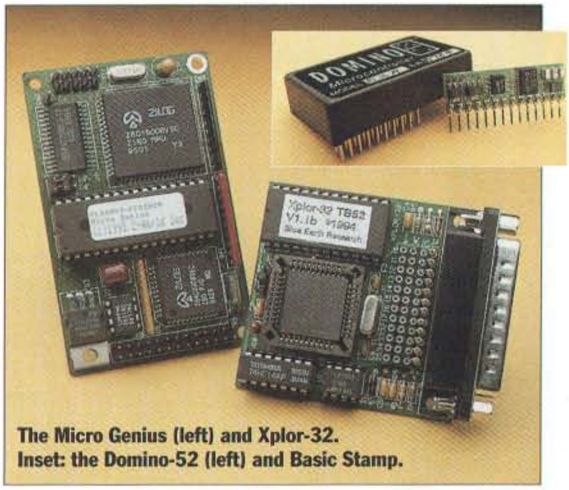
Four development boards from Blue Earth Research, Micromint, Parallax, and Z-World are indicative of this trend. Such systems can include as few as two chips plus a few glue components for power-supply regulation and communications.

The Stamp

Parallax's Basic Stamp is currently king of the miniature hill. Two chips—one serving as the processor, the other acting as the serial EEPROM—do it all (not counting the support circuitry). It all fits on a 16-pin single in-line package (SIP), which you plug into a carrier board during development. The board is not much bigger than the 9-V transistor battery that powers the whole thing. A special cable connects the Stamp to your computer's printer port.

You program the Stamp in an admittedly anemic dialect of BASIC. But this becomes understandable when you recognize that you're working with just 256 *bytes* of program space and 14 *bytes* of variable space.

Parallax has offset the language's limitations, however, with specialized commands. For example, a single Stamp BASIC command can emit a pulse train out of an I/O-port pin (the Stamp has eight of them) with a specified duty cycle.


The Micro Genius (left) and Xplor-32. Inset: the Domino-52 (left) and Basic Stamp.

The Domino Effect

Micromint's Domino-52 comes in a solid epoxy package that looks like an oversize IC (it measures 1.1 by 1.75 inches). Inside is an 80C52 processor with ROM BASIC as well as 32 KB of static RAM (SRAM) and 32 KB of EEPROM (for program storage). A row of 20 pins along the underside provides an 8-bit bidirectional I/O port, a pair of interrupt lines, a serial port, and access to an optional 12-bit, two-channel A/D converter.

As with the Stamp, you program the Domino-52 by plugging it into a carrier board that provides power regulation and communications hardware. Micromint also offers an optional multiwindowed host-based integrated development environment (IDE), called Host52, that serves as an editor/terminal program.

The BASIC dialect understood by the Domino is BASIC52, a reasonably orderly version that's far more robust than the Stamp's BASIC. It supports floating-point, one-dimensional arrays and a kind of rudimentary string handling.

Micro Genius

Compared to the other devices in this review, Z-World's Micro Genius is a Hulk Hogan of capabilities. It uses a Zilog Z180 that runs at 6.144 MHz. The Z180 is a descendant of the venerable Z80 processor with mutated abilities that include, among other things, addressing for up to 1 MB of memory.

The Micro Genius can support a variety of memory configurations. Its base version comes with 32 KB of SRAM and 32 KB of EPROM. The EPROM is socketed, allowing the system to support up to 512 KB of EPROM or 256 KB of EEPROM.

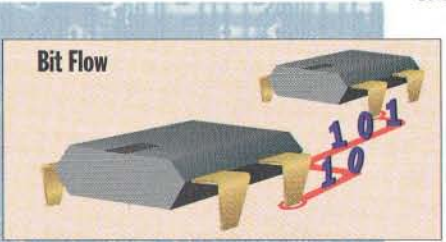
The base-model Micro Genius also includes an RS-232 port (used for communications with the host) and a 555 timer IC configured as an analog input channel for measuring external resistance. Without consuming any additional board space, an upgraded version also has a real-time

TECHNOLOGY FOCUS

Serial Chips

Two things consume board space: parts and traces. The two-chip Basic Stamp reduces the parts count about as far as you could—or would want to—go. Minimizing traces is another matter; you have to be able to get data back and forth between the chips.

That's where serial chips help. For example, the 93LC56 serial EEPROM holds 256 bytes, which for most EPROMs would mean eight data lines and eight address lines to the host CPU. On the 93LC56, that's all handled by four wires: one for chip selection, another for the clock signal, and two more for data in and out. A clever designer can multiplex data in and out, bringing the number of wires down to three.



To read a byte, the CPU sends a command packet to the EEPROM. This command consists of a read op code, followed by the address bits. The EEPROM decodes the command and responds with the 8-bit contents of the requested address. A similar protocol controls write operations. Bits flowing along the data line are synchronized by the clock signal.

Transfers between the CPU and EEPROM can be as fast as 2 Mbps. This is a lot slower than a conventional bus, but plenty fast considering the board-space savings.

Product Information

Basic Stamp
With carrier board...$54
Parallax, Inc.
Rocklin, CA
(916) 624-8333; fax (916) 624-8003
info@parallaxinc.com
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Domino-52
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Micro Genius...$79
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Deluxe version...$395
Z-World
Davis, CA
(916) 757-3737; fax (916) 753-5141
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Xplor-32
Board only...$59.95
Board with cables, power supply, manual, and disk...$99.95
Blue Earth Research
Mankato, MN
(507) 387-4001; fax (507) 387-4008
739-0298@mcimail.com
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clock and an RS-485 circuit (for building "networks" of Micro Geniuses).

You program the Micro Genius with Z-World's Dynamic C, which includes a full-blown IDE that includes an editor, a C compiler, and a debugger. The IDE lets you open watch windows, evaluate expressions, single-step through the executing program, and even examine CPU registers.

Dynamic C is an extended version of C. For example, it supports *costatements*, types of constructs that allow cooperative multithreading. The number of routines and libraries provided is stunning; the package even includes two real-time kernels.

Exploration

Blue Earth Research's Xplor connects to your PC via the serial port. Programming the Xplor is simply a matter of firing up a communications program and entering BASIC code. Once you've entered and debugged your program, that's all there is to it; the code is automatically saved in the Xplor's on-board 4-KB EEPROM. Turn off the Xplor, install it wherever it needs to be, and the next time power is applied, the Xplor executes your program.

I tested the lowest member of the Xplor family tree: the Xplor-32. Its rudimentary I/O hardware consists of 12 digital I/O lines.

The capabilities of the Xplor's version of BASIC fall somewhere between the Stamp's and the Domino-52's. The Xplor's BASIC understands integers only and has no concept of strings or arrays. It provides a set of commands for controlling program flow, as well as special functions for reading the system's built-in A/D converter (functions that are not available on the Xplor-32) and returning the frequency of a wave form at one of the input pins.

Little Is Big

If you do embedded design, these little systems mean big savings. You don't have to spend money on in-circuit emulators, ROM emulators, EPROM burners, and so forth. All you need is a relatively modest PC and some extra space on your desk. ■

Rick Grehan is a senior technical editor for BYTE reviews. He can be contacted on the Internet or BIX at rick_g@bix.com.

URGENT—YOUR INPUT NEEDED

On: Data Communications and Voice Networking

Dear Reader:

To improve BYTE's coverage of technology in the State of the Art section, we'd like your feedback about what topics, areas, and products we should be considering. Early next year, we plan to take a look at where data and voice communications are heading. How much further can we go with analog phone lines and modems before we switch to digital? How about wireless and cellular modems, cable modems, and set-top boxes? What's happening with simultaneous/alternating voice and data. ISDN is starting to arrive, but getting and using it isn't easy, and we're still waiting for asynchronous transfer mode (ATM). What are the real costs of all these new services? These are complex questions. To do them justice, we'd like to know what you're interested in. We want to hear your ideas and find out about concerns that we may not fully appreciate or be aware of. Also, we'd like your help in knowing who are the people we should be talking to.

To let us know what you think, please use the following as a template to send us, via E-mail, an ASCII text file with your comments. Please be sure to include the `<FIELDNAMES>` with their angle brackets, followed by your information and comments. And thanks very much for your help.

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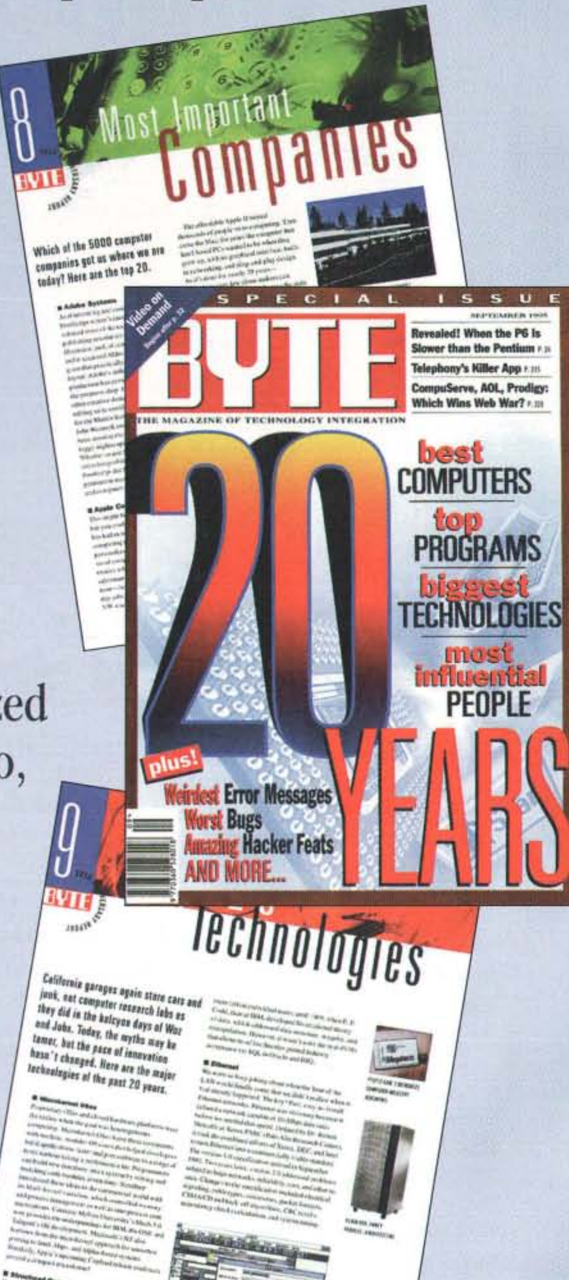
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Industrial-Strength Fax Servers

Six high-end network programs offer company-wide faxing and enough throughput for an entire fax-based business

REX BALDAZO, DAVID ESSEX, AND STAN MIASTKOWSKI

High-powered, server-based fax software can bring faxing to every network user. By placing the fax boards and telecommunications software in a central location, companies can provide the same functions that would otherwise require more costly individual setups.

Networked DOS/Windows fax programs divide broadly into two categories: low-end/client-based and high-end/server-based applications. In this review we evaluate solutions based on dedicated servers that can use several multiline fax boards to handle hundreds of faxes per hour. We're talking about units that can serve, say, 1000 employees during business hours, then broadcast 2000 revised price lists to customers overnight.

To judge overall quality, we considered ease of installation, ease of use, upward scalability, robustness of administrative features, and compatibility with the widest possible range of fax boards and network OSes. Ignoring reports about the difficulty of installing these complex programs, we set out to do six in one month, learning our lessons the hard way. War stories follow...

Though sometimes difficult to install, network fax programs pay off quickly.

FACSys

Optus Software's FACSys 3.40a, a DOS-based fax server for NetWare, packs a surprising number of features and excellent performance into a $995 package.

Installation was remarkably easy. In less than 20 minutes (not including the time it took to set up the fax board), we had FACSys performing its basic functions. After you've logged in to NetWare as a supervisor, FACSys' installation takes care of pesky chores. There's no need to fuss with NetWare's SYSCON or PCONSOLE because FACSys creates its own print queue and grants rights to the group EVERYONE for basic FACSys operation.

One of the most impressive and unique things about FACSys is its wide support of fax devices. Besides the high-performance Brooktrout and GammaLink boards, FACSys supports Intel and PureData units, and all Class 1 and Class 2 fax/modems. Out of the box, it supports up to eight telephone lines and an unlimited number of clients. FACSys also has built-in OCR and built-in E-mail support, including cc:Mail, Novell Groupwise and MHS, and MS-Mail (via MHS only).

Both the DOS and Windows clients include personal and shared phone books and detailed in and out logs (the other five programs offer similar client setups). There's a utility for sending a quick fax, or you can choose the FACSys print queue in Windows Print Manager from your application's print-setup menu.

For its power, FACSys is an excellent value for a small- to medium-size business, especially in view of its wide hardware support and standard features. And it's scalable to larger installations—$2995 buys a multiple-server version that offers fault tolerance and load balancing to handle huge amounts of fax traffic.

continued

The Many Ways to Send a Fax

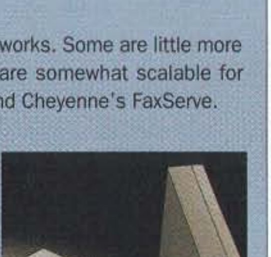
Network faxing comes in four different flavors:

Low-end to mid-range software. Adds fax functions to existing networks. Some are little more than fax modem-sharing utilities. Includes NetWare NLMs that are somewhat scalable for high-end use. Major players: Delrina's WinFax Pro for Networks and Cheyenne's FaxServe.

Mid-range to high-end software. The focus of this review. Often used for mission-critical applications such as broadcasted price updates. Major players: FACSys, LanFax, RightFax.

Hardware/software bundles. Nice for avoiding the pain of software configuration, turnkey systems are available in all the major capacity ranges. Major player: OAZ Communications' Netfax.

Black box solutions. No monitor, hardly any software-installation issues. A neat little box is the server. Major players: Castelle's FaxPress (pictured), U.S. Robotics' Shared Access.



Fax Resource

Resource Partners' Fax Resource runs its server software on Windows instead of in DOS. The server machine can then launch other applications, even faxing from an application running on the same machine as the fax server. Unfortunately, the reality falls short of the potential.

The main hurdle is DOS's 640-KB memory barrier. Naturally, we had to load the various NetWare drivers to put the server on the network. Then we wanted to load the CD-ROM device driver, as well as MSCDEX. The fax server itself requires a large number of file handles. It all added up to insufficient conventional memory to run Windows.

Eventually, by putting DOS's MEMMAKER utility into aggressive mode, foregoing the CD-ROM driver, and tweaking the Fax Resource INI file manually to disable EMS, we were able to get Windows running. But all that did was push our memory problem into Windows, which now had insufficient resources to run the Fax Resource server. Getting desperate (and mad), we installed PC-DOS 7 and ran RAMBOOST, which finally freed enough memory.

The Fax Resource client software lets you print from any Windows program. Address books are in Microsoft Access MDB format, and you are free to create as many as you want. Installing the client software was easier than installing the server package, but the software would not run until we figured out how to authorize user access. (Similar hurdles cropped up when we installed LanFax and Net Satisfaxtion.)

Fax Resource needs some work. We like the Windows server idea, but the drivers need to be smarter about memory. Given time and revision, this could be a good product.

continued

Only Power Servers Need Apply

We tested the six fax server programs that are best able to grow into high-volume, mission-critical applications. Thus, we didn't test some well-known products, such as Delrina's WinFax Pro for Networks and LANSource's Faxport, that are designed more to add client-level fax features than to undergird a high-volume, fax-based business.

To narrow the field further, we looked for software that runs on NetWare networks (though most also work with Microsoft LAN Manager, IBM LAN Server, and others). Our criteria also specified that all of the programs must run on GammaLink's GammaFax boards, the de facto standard for high-end fax systems, though many also support coprocessor-equipped boards from Brooktrout and PureData.

We didn't test an important subcategory of fax server software, NetWare NLMs, such as Cheyenne's FaxServe. Detractors say some network administrators are leery of hanging extra hardware onto their main servers. Both Cheyenne and competitor Tobit Software have taken steps to address these concerns. Supporters say NLMs are cheaper and more NetWare-saavy.

We installed the programs on a prerelease AT&T Globalyst, a 133-MHz Pentium tower with 16 MB of RAM and an 853-MB hard drive. The server machine was connected to our corporate Novell network via thin Ethernet. We used V Communications' System Commander to choose MS-DOS 6.22, PC-DOS 7, or OS/2 Warp at bootup.

The fax board we used for our testing was a high-end GammaLink GammaFax CP4/LSI, stocked with four analog ports, each configurable for either inbound or outbound traffic.

TECHNOLOGY FOCUS

Inside CSID

Most fax machines transmit a Call Subscriber ID (CSID) calling string with the faxes they send. The CSID value can be programmed into the fax machine or entered into a field from the fax software. This subscriber ID is intended to label the specific fax machine, but you can use the string to support different methods of automatic routing.

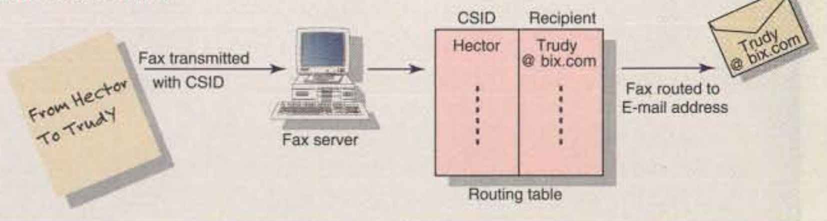
For CSID routing, the fax software builds a table that associates CSID strings to network nodes or E-mail addresses. The software captures the string, then routes the fax to the associated network station or sends the fax via E-mail. The table can also associate a group of recipients to a single CSID.

With CSID, you can set up two basic types of automatic routing:

- If you are the only one in your organization who receives faxes from a specific fax machine (perhaps a supplier or a client who works only with you), your administrator could associate the client's CSID to your network or E-mail address. The fax software would then automatically route any faxes from this machine to you.
- You could also employ a more creative CSID routing method. The administrator could assign CSID strings to specific network addresses or to a group of addresses. When someone wants to send you a fax, you would tell them the CSID code to input. The sender then would change the CSID field (if sending via software) or reconfigure the hardware to transmit the proper CSID. The routing table would capture the designated string and send the fax directly to you or your workgroup. In effect, you would have your own routing code. This will work well as long as the sender knows how to change the CSID at his or her end.

Call Subscriber ID (CSID) routing associates the sender with a fixed E-mail address. Most fax machines transmit a CSID calling string.

The CSID Route



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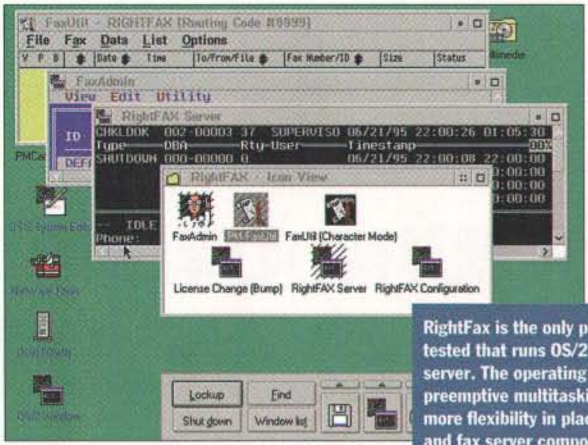

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SHUTDOWN 000-00000 0            06/21/95 22:00:08 22:00:00
```

RightFax is the only product we tested that runs OS/2 on the server. The operating system's preemptive multitasking allows more flexibility in placing file and fax server components on different servers.

LanFax

In a roundup plagued by installation problems, Alcom's LanFax was the worst offender. Once you get past its sore spot, though, LanFax reveals a power and versatility that show why it remains a popular choice for industrial-strength applications.

LanFax requires 550K of conventional RAM, an unrealistic requirement in an environment where loading network drivers high can create other problems. We modified EMM386 parameters to include some memory areas recommended by the manual and ended up with 520K. We were then able to run the LanFax server program—that is, after hours of flipping through manuals; editing DOS configuration files; searching for, modifying, and creating special configuration files; second-guessing instructions; and so on.

To set up the client software, we had to load a runtime version of Borland's Paradox and use it to call .DB files that the installation program had not placed where the manual said they would be. We then were told to run a network communication TSR. Ultimately, we brought up LanFax's Windows client and were now quickly sending and receiving faxes. Notification of incoming faxes is clear and intuitive, with point-and-click access to a fax viewer.

LanFax comes with an array of traffic-management, fax, and other communication features. It can work alongside other packages, such as Delrina's WinFax Pro and Cardiff's Teleform. Programmers will appreciate the API access to DOS/Windows libraries and Windows DLLs.

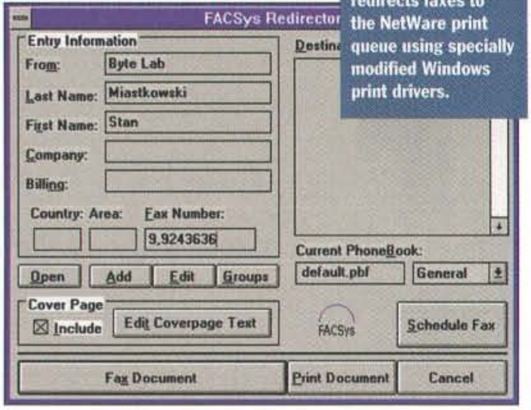
With a capacity of 8000 users and 32 lines per server, LanFax is built for large installations. It's a technically impressive product with a multitasking design that allows parallel task processing, and it has transport-layer support for network operating systems. But its size and complexity could scare off customers with somewhat less ambitious plans.

Net Satisfaxtion

Version 3.0 of Delrina's Net Satisfaxtion adds support for GammaLink GammaFax boards, though the program's 1000-user, eight-line capacity exposes its background as a midrange product. Delrina, which acquired the software from Intel after our testing was completed, plans to add its WinFax front end to the next major upgrade of Net Satisfaxtion.

Delrina's installation software and supporting documentation are the best of this group. The program guides you in the prop-

Optus's FACSys Redirector dialog box pops up over third-party applications. The program redirects faxes to the NetWare print queue using specially modified Windows print drivers.



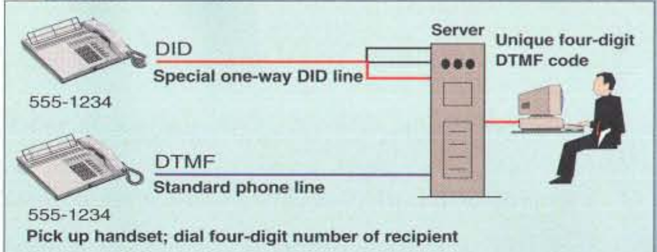
From: Byte Lab
Last Name: Miastkowski
First Name: Stan
Company:
Billing:
Country: Area: Fax Number: 9,9243636
Current PhoneBook: default.pbf General
☒ Include

Fax Routing: You Can't Get There from Here

Fax routing is a huge problem for fax vendors and for enterprises implementing network-based faxing. All fax server software offers at least the first three options listed below.

Manual in-bound routing is reliable but inconvenient. A person views incoming cover sheets and redirects the fax files using software. The drawback: labor intensive.

DTMF-based routing employs the beeps of Touch-Tone phones to transmit numbers that identify recipients. The software sets up dual-tone multifrequency (DTMF) aliases for client workstations. DTMF requires that senders know the recipient's code and can enter it from the fax machine touchpad.


DID
Special one-way DID line
555-1234
DTMF
Standard phone line
555-1234
Pick up handset; dial four-digit number of recipient
Server
Unique four-digit DTMF code

DID lines are inbound-only and require special hardware and installation, while DTMF uses standard analog lines. Both produce the same type of DTMF tones that are interpreted by the fax software.

Direct inward dialing (DID) requires a special trunk line that sends faxes directly to the correct recipient using the final four digits of a unique fax number. It is one of the most reliable methods but is expensive because of the extra lines and equipment.

Call Subscriber ID (CSID) uses a string transmitted to the receiving station. A routing table associates the CSID with the proper network or E-mail address.

Line routing (or channel routing) is the simplest, most reliable, and usually most expensive approach. Requires a separate phone line for each recipient or workgroup.

OCR reads the recipient's name from the cover sheet and exports it to the server's user database. Matching the OCR engine's guesses against the database of network users can improve the odds.

T.30 subaddressing uses coding contained in the T.30 protocol for fax transmission. Potentially the best combination of affordability and reliability, T.30 has not been adopted widely yet.

These are the most popular routing methods. Vendors add their own. Delrina's Net Satisfaxtion, for example, lets you add the recipient's network user name.

Network Faxing... The Next Generation

Marc Bisnaire & Andrea Quesnelle

With the recent release of Windows95 and of WindowsNT, network faxing is evolving, and with it emerges the next generation. So how to define the "next generation" of network fax products? Two main factors emerge: usability (including re-usability) and tighter integration, with both the network and the desktop.

User needs... user costs...

Training costs and usability are major considerations when selecting a network fax solution. How much time will it take to bring users up to speed? Will they use all of the available features? Start by selecting the right user interface - one that is well laid out and simple to follow, such as FAXport from LANSource Technologies. When seeing FAXport for the first time, most users are already "familiar" with how it works, as the user interface seems to neatly mesh the best of most every single-user fax software.

One Button Faxing. Since many users often forget to change the printer driver or simply don't know how to, faxing should be as easy as pressing ONE button. FAXport does this admirably, by including a FAXmenu button on screen that automatically selects the fax-printer driver without changing the default. This saves time and frustration.

Integration... Integration...

Next generation network faxing must be able to integrate and customize fax functionality into various desktop applications. Next generation network faxing products require OLE Automation, DDE, and a DLL API to provide all fax functions from send, to receive, to status updating. FAXport provides all three APIs. With over 140 OLE Automation functions available and using, say, Visual Basic as your scripting language, you can tightly integrate network faxing into various applications.

WinFax(TM) Compatibility. Like it or not, WinFax has a large market share, and many users have it installed on their PCs. Any network fax solution should also include the best features of this software, but more importantly, be able to read WinFax phonebooks, view WinFax images and even use WinFax DDE links. FAXport does exactly that only better; it's a true network FAX Server solution. With FAXport, a corporate solution has no holdouts, making it easier to administer.

UNC Support. With WindowsNT and Windows95 comes the need to support UNC (Universal Naming Convention), i.e.: the means by which to replace drive mappings with the actual location of the files. Think "\\Server\volume\filename" instead of "H:\Filename". This becomes very useful when you know where a file is but not on what drive.

ODBC Compliant Phonebooks. Next generation network faxing should allow use of almost any data source as a fax phonebook. That means ODBC! FAXport's ODBC Mapping program, allows you to MAP any ODBC database (datatable to the purest) to a FAXport phonebook. The three table design displays the FAXport phonebook format, a link column, and the ODBC table format. This ingenious design lets you drag & drop the data field into the link column to match the FAXport phonebook format.

More & more & more faxing

Bulk faxing is an increasingly necessary, albeit painful, marketing tool in many companies. A next generation fax product has to make this task accessible to all as easily as sending a single fax. The fax server should do all the work - generating individual cover pages, adding network attachments, sending at the optimum time, all with meaningful reporting. In this way, it increases sales potential and customer satisfaction. FAXport does exactly that. Users can send bulk faxes the same way they'd send a single fax; the only difference is that you select one or many phonebooks, instead of a single address, as the destination.

The next generation fax product must include an advanced Cover Page/Form Designer, that is OLE 2.0 enabled and capable of customizing faxes by inserting fax phonebook fields that the fax server can then read and fill. It must also allow you to add custom entry fields, related to a database of your choosing, in order to create the right form for faxing. FAXport's Cover/Form Page Designer provides all of these capabilities.

The 32 bit world

For the corporate network, reality has evolved into a 32 bit world, with WindowsNT and Windows95 at its centre. Ironically, not all fax softwares have a 32 bit version, let alone a 32 bit fax server that runs as a service on NT. FAXport, however, provides these, as well as a 32 bit client software for both Windows95 and WindowsNT, and even a great Windows version for those who choose to live in a 16 bit world a little longer.

Overall, next generation network fax software needs to integrate more with the changing reality both on the network and on the desktop. LANSource Technologies Inc.'s FAXport is an excellent example of a next generation product that addresses these factors effectively, at a very competitive price. A 5 user, 4 modem version starts at only U$399. ■

Andrea can be reached at andrea@lansource.com

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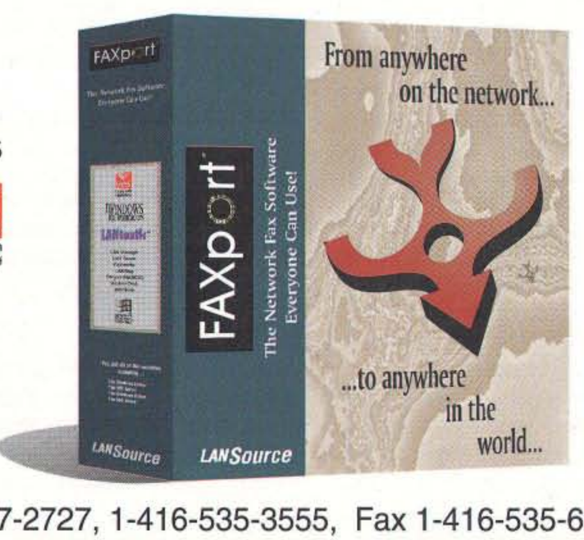
Microsoft Windows95

MICROSOFT. WINDOWS. COMPATIBLE

yes It runs with NetWare

Microsoft BackOffice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FAX SERVER FEATURES COMPARED

	FACSYS	LANFAX	NET SATISFAXTION	OBJECTFAX	FAX RESOURCE	RIGHTFAX
ADMINISTRATION						
Event log is exportable	●	●	●	●	●	●
Fax board is software configurable	●	●	●	●	●	●
Supports passwords for inbound faxes	●	●	●	●	●	●
Has integrated billing module	●	●	●	○	○	●
FAX						
Major boards supported (B=Brooktrout, G=GammaFax, I=Intel, P=PureData)	B, G, I, P	G, I, P	G, I, P	B, G	G, I, P	B, G
Maximum number of users/lines	Unlimited/8	8000/32	1000/8	4096/32	Unlimited/160	Unlimited/24
Supports binary file transfer	●	●	●	○	○	●
NETWORK						
Networks supported	NetWare	NetWare, LAN Manager, LAN Server, LANtastic, Vines, etc.	NetWare	NetWare, LANtastic, Vines, Pathworks, etc.	NetWare, LAN Manager, LAN Server, LANtastic, NT, etc.	NetWare, LAN Server
Handles image conversion on server	●	●	●	○	●	●
Allows remote installation of client software	●	●	●	○	●	●
Client OSes	DOS, Windows	DOS, Windows	DOS, Windows	DOS, Windows	DOS, Windows	DOS, Windows, OS/2
ROUTING						
CSID	●	●	●	●	●	○
DID	●	●	●	●	●	●
DTMF	●	●	●	●	●	●
Line (channel)	●	●	○	●	●	●
OCR	●	○	●	●	○	●
T.30 subaddressing	●	●	○	●	○	○
SERVER						
Operating system	DOS	DOS	DOS	DOS	DOS/Windows	OS/2
Minimum CPU	286	386	386	286	20-MHz 486SX	386
Minimum RAM	2 MB	8 MB	3 MB	640 KB	4 MB	12 MB
Minimum hard disk capacity	—[1]	100 MB	40 MB	30 MB	80 MB	200MB
WORKGROUP						
Builds phone book from NetWare Bindery	●	●	○	○	○	●
Number of E-mail protocols supported	2	4	—[2]	3	4	4
Supports MAPI	○	●	○	●	●	●
Supports MHS	●	●	○	○	○	○
Supports VIM	●	●	○	●	●	●

Yes = ● No = ○

[1] Faxes are stored on NetWare file server.

[2] Available via third-party CAS gateways.

er order through all the required steps. The administrative module is straightforward and lets you establish user privileges by choosing names in a list imported from the NetWare Bindery.

While far less feature-rich than LanFax or RightFax, Net Satisfaxtion nonetheless has numerous features that mark it as a contender for mission-critical operations. It supports direct inward dialing (DID) (see the text box "Fax Routing: You Can't Get There from Here" on page 140), and it comes with billing options that are useful for setting up a fax-based line of business. Its unique drawback: minimal support for E-mail.

ObjectFax

ObjectFax, from Traffic Software, was one of the easiest programs to set up. The installation module for the server is a Windows program that copies all the files to a NetWare file server. (The fax server itself is a DOS application and does not run on the file server.) The installation program also sets up a Windows administrator program to configure the fax board and lines.

The client software includes an inbox toolbar; for administrators, the toolbar includes configuration buttons. Once we installed it on the client, we found that using ObjectFax is as simple as selecting the ObjectFax printer and printing. From a floating toolbar, you can call a simple text editor to fax a short note. You can even create standard attachments that are then available from the program's toolbar.

While ObjectFax directly supports only DOS and Windows clients, an API option allows the enterprising programmer to access the fax server from any platform connected to the file server.

RightFax

A full-fledged multitasking, multithreading native OS/2 application, RightFax is designed for serious high-volume faxing in medium-to-large organizations. That target market is most evident from its pricing:

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Net Satisfaxtion 3.0
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1000-user version $1995
Delrina
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(408) 363-2345
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fax: (407) 995-5272
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RightFax 4.0
single channel, unlimited users $995
each additional channel $795
RightFax
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fax: (520) 321-7456
fax on demand: (520) 327-1288
sales@rightfax.com
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$995 buys you a very basic one-telephone-line license. Each additional line costs $795. It can add up quickly. For example, a four-line RightFax installation with OCR and E-mail support costs $5970, and that's not counting hardware.

Because of OS/2's true preemptive multitasking, you can install RightFax along with an OS/2 NetWare server, E-mail or voicemail server, or put all of them on the same system. You can also install RightFax in a file server configuration (whether on the same or different hardware as your NetWare). A file server installation supports fax annotation, which isn't available with a dedicated fax server. However, resource and performance issues make a dedicated fax server the best bet for all but the smallest installations.

RightFax posed another difficult installation. You need the latest version of the NetWare Requester for OS/2. Even if you already have it, you'll probably need to reinstall it to make sure it's set for Global NetWare Shell Support and both client and server support. But that's just the beginning. You also must have NetWare Administrator privileges. And you need to fiddle with both SYSCON and PCONSOLE before installing the RightFax software, setting up a RightFax user account and establishing a print queue. Unlike FACSys and Net Satisfaxtion, RightFax doesn't do a quick basic installation that you can dink with later.

Installing the client is simple. In Windows, RightFax has the handy PowerBar (see the screen on page 140). This is a floating and customizable icon bar that gives you quick access to a phone book, in/out box, and a utility for almost-instant faxing. The PowerBar has icons to instantly switch between your default printer and the RightFax queue. You can also drag and drop document icons onto the fax icon in the PowerBar.

RightFax has extensive support for use of billing codes. You can even prevent people from sending faxes unless billing codes are entered.

Playing Favorites

When we judge all six programs by our general criteria of user friendliness and upward scalability, Optus' FACSys pulls ahead of the pack. Its rich hardware compatibility, ease of use, and tight integration make it a comfortable fit for most applications. FACSys appears to do the best job of accommodating both mid-range network faxing and high-end, mission-critical applications. Adding cards and servers lets FACSys scale up as demand grows. FACSys works only with NetWare, but a Windows NT version provides wider network compatibility.

Following a close second is Traffic Software's ObjectFax. It sports the best-looking client interface, a fairly advanced object orientation to faxing, and an API that we may use someday to provide interoperability with our Macintosh clients. ■

Rex Baldazo and David Essex are BYTE technical editors. Stan Miastkowski is a consulting editor. You can reach them on the Internet at rbaldazo@bix.com, dessex@bix.com, and stanm@bix.com.

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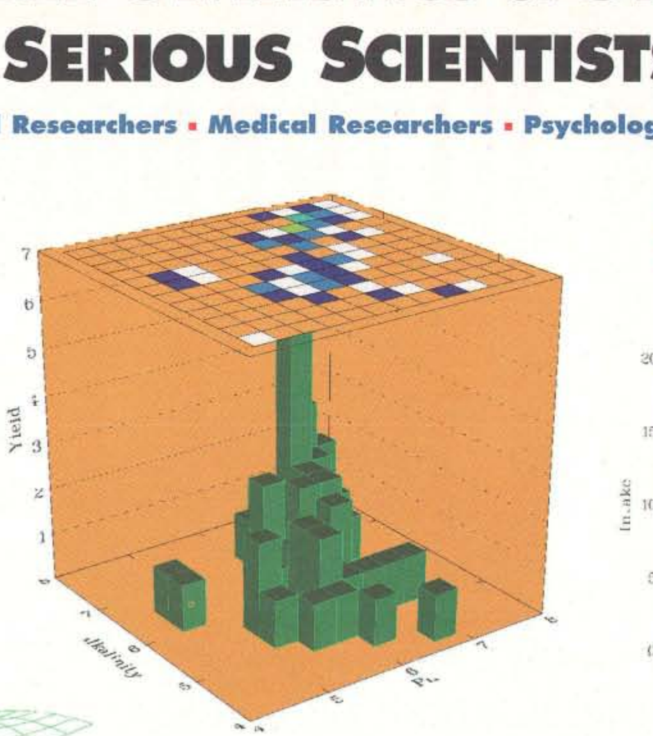

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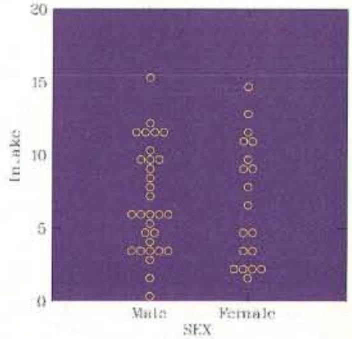

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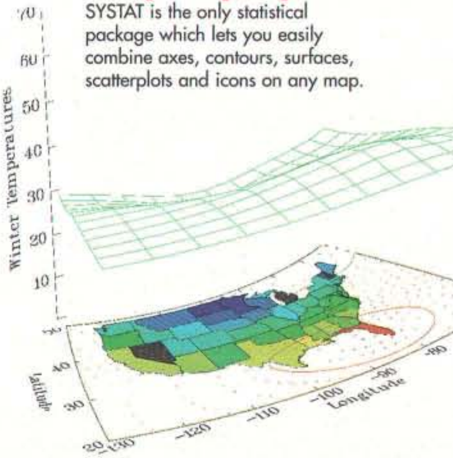

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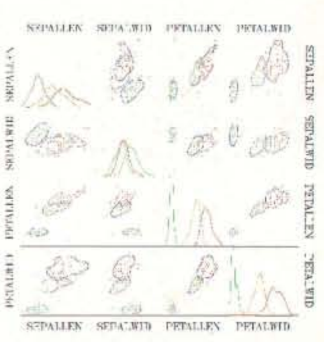

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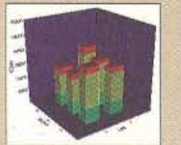

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11 ULTRAPORTABLES GO THE DISTANCE

On the road again? These portables weigh in at about 6 pounds and offer near-desktop-level performance, great displays, large hard drives, and loads of useful features.

ANTHONY J. LENNON AND JOHN MCDONOUGH

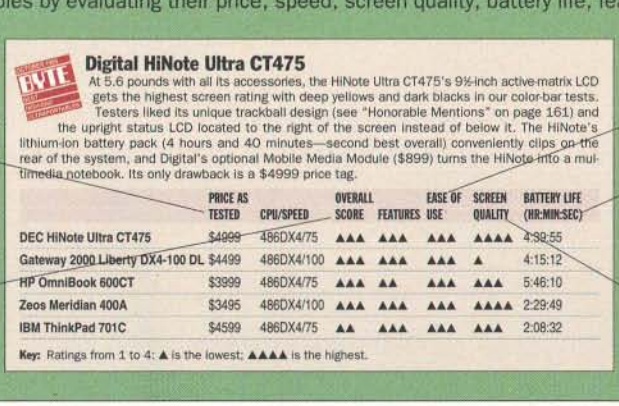
They say the universe is expanding, but hardened road warriors know better: Time and space seem to converge when you're working in cramped quarters while in transit. With this in mind, we tested 11 ultraportables that provide near-desktop performance while you're in the back seat of a cab or flying above the clouds. These ultraportables may be petite machines, but they don't suffer from the features-deprivation complex that afflicted their subnotebook predecessors. Some of the systems we tested are resplendent with color active-matrix displays, zippy Pentium CPUs, and hard drives with over 500 MB.

Ultraportables have their drawbacks (e.g., most require external floppy drives), but they are catching up to heavier notebooks in terms of functionality. Battery life is getting longer (3½ hours on average; Hewlett-Packard's OmniBook 600CT lasted an incredible 5 hours and 46 minutes in the Thumper II tests), as many vendors migrate from nicad batteries to nickel-metal-hydride (NiMH) and lithium-ion batteries.

The majority of these ultraportables house Intel's SL-enhanced 486DX4 processor (either 75 or 100 MHz), and four of them have active-matrix displays. As a rule of thumb, expect to spend at least $700 more for a system that has an active-matrix

How to use this guide

We selected the best ultraportables by evaluating their price, speed, screen quality, battery life, features, and ease of use.



Digital HiNote Ultra CT475

At 5.6 pounds with all its accessories, the HiNote Ultra CT475's 9½-inch active-matrix LCD gets the highest screen rating with deep yellows and dark blacks in our color-bar tests. Testers liked its unique trackball design (see "Honorable Mentions" on page 161) and the upright status LCD located to the right of the screen instead of below it. The HiNote's lithium-ion battery pack (4 hours and 40 minutes—second best overall) conveniently clips on the rear of the system, and Digital's optional Mobile Media Module ($899) turns the HiNote into a multimedia notebook. Its only drawback is a $4999 price tag.

	PRICE AS TESTED	CPU/SPEED	OVERALL SCORE	FEATURES	EASE OF USE	SCREEN QUALITY	BATTERY LIFE (HR:MIN:SEC)
DEC HiNote Ultra CT475	$4999	486DX4/75	▲▲▲	▲▲▲	▲▲▲	▲▲▲▲	4:39:55
Gateway 2000 Liberty DX4-100 DL	$4499	486DX4/100	▲▲▲	▲▲▲	▲▲▲	▲	4:15:12
HP OmniBook 600CT	$3999	486DX4/75	▲▲▲	▲▲	▲▲▲	▲▲▲	5:46:10
Zeos Meridian 400A	$3495	486DX4/100	▲▲▲	▲▲▲	▲▲▲	▲▲▲▲	2:29:49
IBM ThinkPad 701C	$4599	486DX4/75	▲▲	▲▲▲	▲▲▲	▲▲▲	2:08:32

Key: Ratings from 1 to 4: ▲ is the lowest; ▲▲▲▲ is the highest.

See the Roll Call on pages 164–165 for features included at this price.

A combination of the weighted scores for performance, screen quality, features, battery life, and usability.

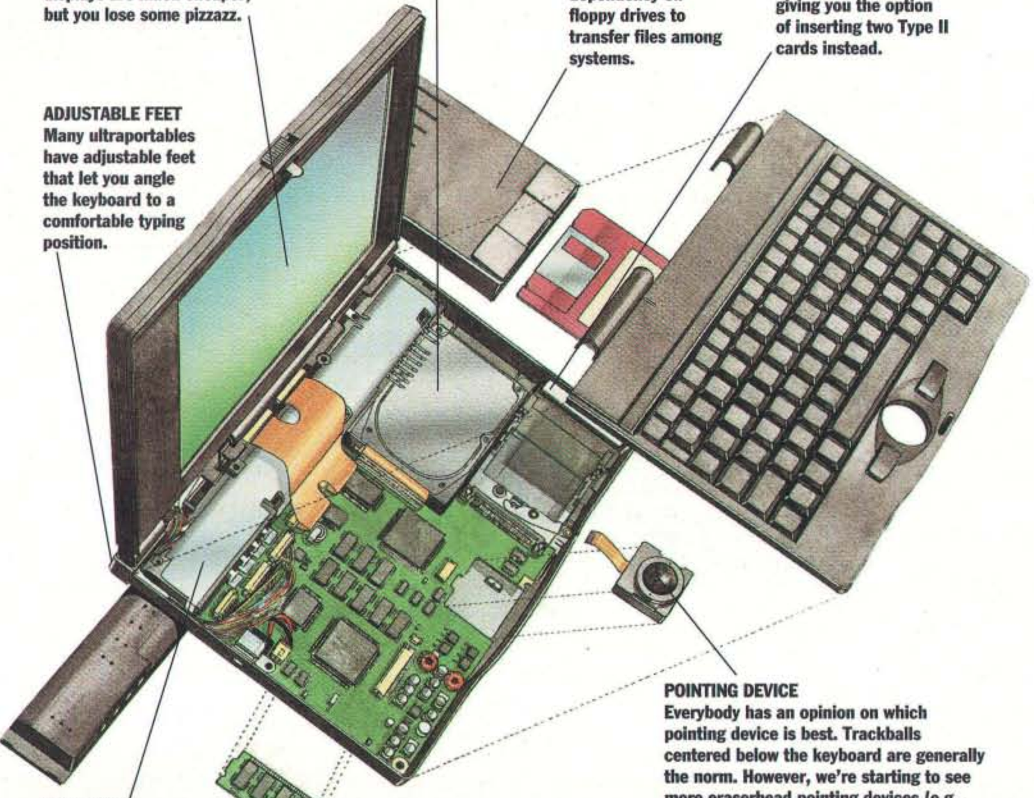
A subjective assessment of the keyboard layout and feel, pointing device, status lights, and other considerations.

Based on BYTE's Thumper II battery run-down test.

This rates the display's crispness, intensity and color range, and range of viewing angles.

PHOTOGRAPHY: STEVE BELKOWITZ © 1995

Lightweights with a Punch



LCD
The days of monochrome displays are gone—color rules, and active-matrix LCDs produce the most striking tints and hues. Systems with passive-matrix and dual-scan displays are much cheaper, but you lose some pizzazz.

REMOVABLE HARD DRIVE
Some ultraportables have a modular design that makes it easy to swap hard drives and upgrade when necessary.

EXTERNAL FLOPPY DRIVE
A necessary evil with most ultraportables. The Internet and networks, however, are decreasing our dependency on floppy drives to transfer files among systems.

PC CARD SLOTS
All but four of these ultraportables support one Type III card, giving you the option of inserting two Type II cards instead.

ADJUSTABLE FEET
Many ultraportables have adjustable feet that let you angle the keyboard to a comfortable typing position.

POINTING DEVICE
Everybody has an opinion on which pointing device is best. Trackballs centered below the keyboard are generally the norm. However, we're starting to see more eraserhead pointing devices (e.g., IBM's TrackPoint III) on ultraportables and notebooks.

BATTERY
Ultraportables with lithium-ion batteries generally outlast those with nicad and nickel-metal-hydride (NiMH) batteries, but the latter are less expensive.

OCTOBER 1995 BYTE BEST ULTRAPORTABLES BEST

BEST HIGH-END ULTRAPORTABLE

Digital Equipment HiNote Ultra CT475

If you've got the money ($4999), Digital's HiNote Ultra CT475 is the perfect travel companion. Its 9½-inch active-matrix display produces vibrant, fully saturated colors—the best in our screen-quality tests. This ultraportable with a 75-MHz 486DX4 has a lithium-ion battery pack that powers it for over 4½ hours in our Thumper II battery run-down test. The system has 16-bit sound and supports an optional multimedia module for business presentations.
PAGE 148

BEST LOWER-COST ULTRAPORTABLE

AT&T Globalyst 130

This ultraportable looks more like a notebook system with its integrated floppy drive and 10.4-inch, passive-matrix LCD. It didn't do well in our performance benchmarks, but it lasted about 4 hours in the Thumper II test. The Globalyst has easy-to-read status indicators, a wide viewing angle, a large trackball, and an expansive wrist rest. Its $2223 price won't give you sticker shock.
PAGE 150

display than one with a dual-scan display. Active-matrix displays usually give you a wider viewing angle and fill the screen with brighter colors.

Constrained by such a small form factor, vendors have come up with some unique designs. The keyboard of IBM's ThinkPad 701C literally jumps out at you, the mouse on HP's OmniBook pops out the side, and several systems have infrared ports that let you transfer files with your desktop system, sans serial cables.

These innovations don't come cheap, however. The average price of an active-matrix ultraportable in this report is $4273. The Compaq Contura Aero 4/33C Model 250 and the Sceptre Technologies TS37 Subnotebook dip below $2000, but they don't have as many features as the higher-end systems.

Because vendors had difficulty squeezing their systems through our tight testing criteria, we reviewed fewer machines than normal. To be included, an ultraportable had to weigh 5 pounds or less without accessories or about 6 pounds with accessories (e.g., an AC adapter, a floppy drive, a battery, and so on). It had to have at least a 25-MHz 486SX CPU, 8 MB of RAM, a 200-MB hard drive, a color display, a 3½-inch floppy drive, and an integrated pointing device.

We divided the systems into two categories: high-end ultraportables priced above $3000 and the lower-cost alternatives. Our performance tests use Windows and DOS applications, such as Word, Excel, WordPerfect, and FoxPro, that measure how fast these featherweights are in real-world situations. The low-level InterMark suite tests stress system components, such as graphics and storage subsystem components under Windows.

ILLUSTRATION: BRUCE SANDERS © 1995

High-End Ultraportables

We tested five high-end ultraportables that should reduce a road warrior's fears about taking to the streets. These systems cost you dearly at $3495 or higher, but they all feature 486DX4 processors, and all but the Gateway 2000 Liberty DX4-100 Deluxe have active-matrix displays.

What Gateway's Liberty lacks in screen quality, however, it makes up for in performance by surpassing all the others in our high-level InterMark benchmarks. The Liberty is truly built for speed, with 24 MB of RAM and a 100-MHz 486DX4 processor. It is also the only one with 256 KB of secondary cache memory. The Zeos Meridian 400A also has a 100-MHz 486DX4 and draws bit-mapped Windows images faster than the Liberty does.

The Liberty has an expansive, 10.4-inch dual-scan LCD that surprisingly scored lower than many passive-matrix displays in our screen-quality tests. Testers believed that its colors were somewhat washed out in our color-bar test. The remaining high-end ultraportables did much better in the screen-quality tests, thanks to their active-matrix LCDs.

We were also impressed with the unique designs of the ultraportables. IBM's ThinkPad 701C, which was held back by its short battery life (2 hours and 9 minutes), has a TrackWrite keyboard (known as Butterfly) that slides out and extends over the edges of the chassis. The 85-key keyboard is surprisingly firm to the touch. Our winner in this category, the slick-looking Digital Equipment HiNote Ultra CT475, features a Floppy Dock, which houses a 3½-inch floppy drive and connects underneath the HiNote; it angles the keyboard, increasing typing comfort. Also, the HiNote, the ThinkPad 701C, and the Hewlett-Packard OmniBook 600CT have built-in sound with high-quality speakers, and the latter two have built-in microphones.

Digital HiNote Ultra CT475

At 5.6 pounds with all its accessories, the HiNote Ultra CT475's 9½-inch active-matrix LCD gets the highest screen rating with deep yellows and dark blacks in our color-bar tests. Testers liked its unique trackball design (see "Honorable Mentions" on page 161) and the upright status LCD located to the right of the screen instead of below it. The HiNote's lithium-ion battery pack (4 hours and 40 minutes—second best overall) conveniently clips on the rear of the system, and Digital's optional Mobile Media Module ($899) turns the HiNote into a multimedia notebook. Its only drawback is a $4999 price tag.

	PRICE AS TESTED	CPU/SPEED	OVERALL SCORE	FEATURES	EASE OF USE	SCREEN QUALITY	BATTERY LIFE (HR:MIN:SEC)
DEC HiNote Ultra CT475	$4999	486DX4/75	▲▲▲	▲▲▲	▲▲▲	▲▲▲▲	4:39:55
Gateway 2000 Liberty DX4-100 DL	$4499	486DX4/100	▲▲▲	▲▲▲	▲▲▲	▲	4:15:12
HP OmniBook 600CT	$3999	486DX4/75	▲▲▲	▲▲	▲▲▲	▲▲▲	5:46:10
Zeos Meridian 400A	$3495	486DX4/100	▲▲▲	▲▲▲	▲▲▲	▲▲▲▲	2:29:49
IBM ThinkPad 701C	$4599	486DX4/75	▲▲	▲▲▲	▲▲▲	▲▲▲	2:08:32

Key: Ratings from 1 to 4: ▲ is the lowest; ▲▲▲▲ is the highest.

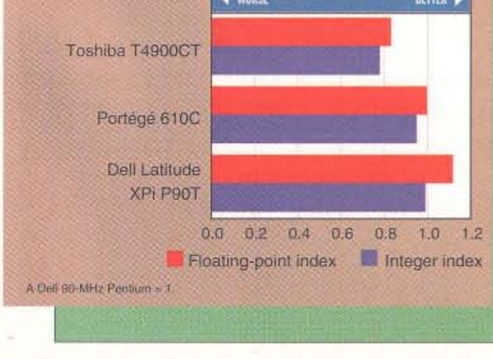
Clockwise from lower right: IBM's ThinkPad, Digital's HiNote, Zeos's Meridian 400A, Gateway's Liberty, and HP's OmniBook display NSTL's color-bar test.

THE INCREDIBLE SHRINKING PENTIUM

A laptop can never be too fast nor weigh too little. Toshiba America Information Systems (Irvine, CA, (714) 583-3000) has applied both these lessons well in designing the Portégé 610CT.

Like the Dell Latitude XPi P90T (see "Impressive Battery Life in a Laptop Pentium PC," September BYTE, page 286), the Portégé 610CT uses Intel's low-power Pentium clocked at 90 MHz. The 610CT uses extended data out (EDO) RAM, which, in certain circumstances, can improve performance. However, on our BYTEmark native-mode tests (see the chart), the scores were just about on par for a normally aspirated 90-MHz Pentium. That's not to say the extra expense of EDO RAM is wasted, but our low-level tests did not show a noticeable speedup.

Pentium Performance



The benefit of a low-power microprocessor was readily apparent in our Thumper II word processing battery-life test. The smaller 610CT bested its big brother, the T4900CT (4 hours and 25 minutes), running 5 hours unplugged.

Toshiba's Portégé 610CT.

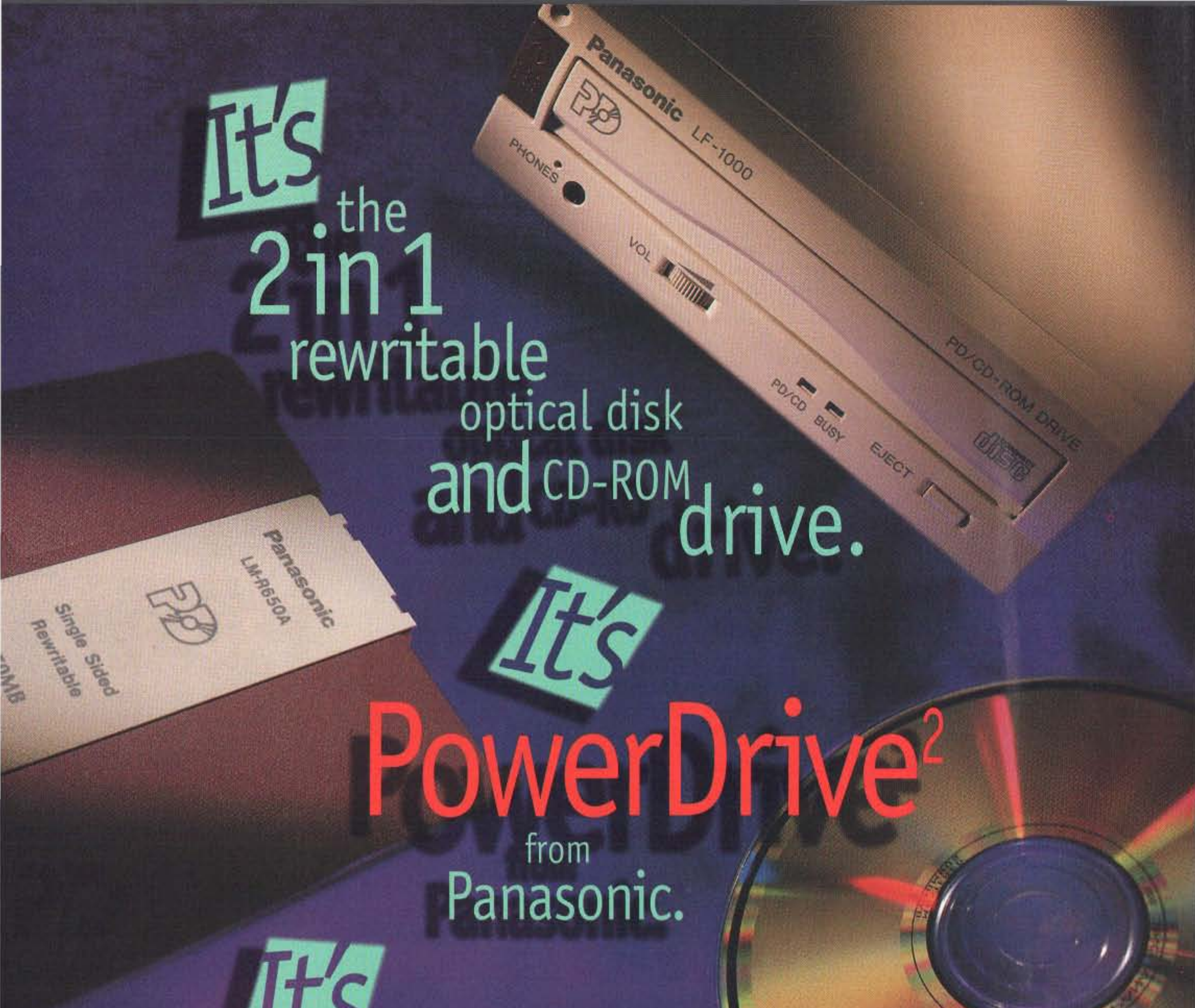
Many of the pieces in the 610CT seem familiar—almost ordinary: built-in 16-bit sound and a 9½-inch color thin-film transistor (TFT) display. But this computer is more than the sum of its parts. Somehow, Toshiba has managed to put the equivalent of a full-featured desktop Pentium into an elegant package that weighs under 5 pounds.

This achievement is not without some sacrifices. The floppy drive is an external unit, as is the AC power brick. But the biggest drawback is the tiny keyboard. IBM's magnificent Butterfly keyboard (see "Incredible Expanding Keyboard," May BYTE) has simply set the bar higher, and the Portégé 610CT does not rise to the challenge. A cramped keyboard used to be a trade-off we would accept to gain better portability. Now that someone has shown the world a better way, anything else seems like a step back.

Toshiba has once again delivered an amazing amount of power in a small form factor. Now if the company can just convince IBM to license the Butterfly keyboard, this could be the perfect traveling companion for the mobile professional. —Rex Baldazo

Product Information

Portégé 610CT
8 MB of RAM, 686-MB
hard drive $464
Toshiba America
Information Systems, Inc.
Irvine, CA
(800) 334-3445
(714) 583-3000
Circle 1247 on Inquiry Card



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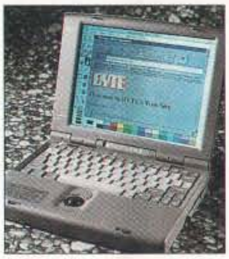
Circle 84 on Inquiry Card.

Lower-Cost Alternatives

The lower-cost ultraportables we tested averaged $2100 less than the high-end ultraportables. Four of the systems carry passive-matrix displays, and the other two use dual-scan LCDs. Passive-matrix displays cost less and consume less power than active-matrix displays, but the tradeoff is inferior color, lower contrast, and slower video response. Some of the lower-cost ultraportables, however, surprised us when we ran our screen-quality tests.


AT&T Globalyst 130.

The AT&T Globalyst 130 offers the widest viewing angle and plenty of real estate on its 10.4-inch passive-matrix display as measured by NSTL's Heads-Up Range Device (HURD), which determines an ultraportable's maximum viewing angle from left to right and by tilting the screen backward. Both Austin Direct 486 StepLite Notebook models feature 9½-inch passive-matrix LCDs with wide viewing angles, which produced strong color scores. The least expensive models, Compaq's Contura Aero 4/33C Model 250 ($1199) and Sceptre Technologies' TS37 Subnotebook ($1695), however, did poorly on the color tests. Also, the Contura Aero's 7.8-inch passive-matrix LCD maxes out at 16 colors.

At $2795, the Zeos Meridian 400C costs more than the other ultraportables in this category, but its 100-MHz 486DX4 processor powers it to the third-best performance scores of all the products. You pay a price for the speed, however; life gets sucked out of the Meridian 400C's nickel-metal-hydride (NiMH) battery (2 hours and 30 minutes) much faster than the other lower-cost ultraportables (which averaged 3 hours and 36 minutes). At the other end of the performance spectrum are the Sceptre TS37 Subnotebook and the Contura Aero, which use 33-MHz 486SX processors. They dragged through our performance benchmarks but had longer battery lives than that of the Meridian 400C.

The AT&T Globalyst 130, TS37 Subnotebook, Contura Aero, and the two Austin models have trackballs of assorted sizes and placement, while the Meridian 400C has an eraserhead to the right of the handrest with left- and right-click buttons on the front of the chassis. This makes it easy to click with your thumb while keeping a finger on the eraserhead. When it comes to trackballs, we find the bigger, the better.

AT&T Globalyst 130

The AT&T Globalyst 130 looks more like a traditional notebook than an ultraportable with its integrated floppy drive and wide, 10.4-inch passive-matrix display. Nevertheless, the $2223 ultraportable weighs only 6.1 pounds with all its accessories. AT&T picked its components carefully to make sure its system was affordable, with enough features to satisfy any traveling businessperson. Its long-lasting NiMH battery (3 hours and 52 minutes), 340-MB hard drive, and 75-MHz 486DX4 processor give it respectable performance for road work.

	PRICE AS TESTED	CPU/SPEED	OVERALL SCORE	FEATURES	EASE OF USE	SCREEN QUALITY	BATTERY LIFE (HR:MIN:SEC)
AT&T Globalyst 130	$2223	486DX4/75	▲▲	▲▲▲	▲▲▲	▲▲▲	3:52:28
Zeos Meridian 400C	$2795	486DX4/100	▲▲	▲▲▲	▲▲▲	▲▲	2:20:39
Austin Direct 486 StepLite	$2407	486DX4/75	▲▲	▲▲▲	▲▲▲	▲▲	3:18:33
Austin Direct 486 StepLite	$2065	486DX4/50	▲▲	▲▲▲	▲▲▲	▲▲▲	2:52:15
Sceptre TS37 Subnotebook	$1695	486DX/33	▲▲	▲▲	▲▲▲	▲	3:31:48

Key: Ratings from 1 to 4: ▲ is the lowest; ▲▲▲▲ is the highest.

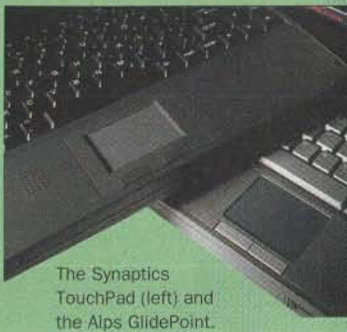
TOUCHPADS TO NAVIGATE BY

An individual's taste in pointing devices, like music and art, is highly subjective. Some of us love IBM's TrackPoint device, while some can't quite get the hang of it. Touchpads, too, claim devotees and naysayers, but the technology has made some notable advances over the last few years.

The first widely available touchpad for portables is Alps Electric's (San Jose, CA, (800) 825-2577) GlidePoint (see "Do the Electric Glide," April BYTE, page 203), which uses field-distortion sensing, a capacitance-sensing technology licensed from Cirque (Salt Lake City, UT). The two layers of electrical conductors, arranged in a grid, generate an electrical field over the GlidePoint's surface. Your fingertip distorts the field, and the GlidePoint determines the exact location of your fingertip by sensing the strength of the distortion at each conductor.

For comparison purposes, we tried the Cirque technology on a Sharp PC-8900 that comes standard with a GlidePoint. It takes some getting used to, especially the tapping motions required to trigger mouse-clicks, double-clicks, and click and drag. But once you get a feel for it, the GlidePoint is a natural way to navigate a cursor around the screen. You run into trouble, however, when you're dragging an item and your finger runs into the edge of the pad. With the GlidePoint driver, you can configure the right mouse button to act as a drag-lock key, but that's not the best solution.

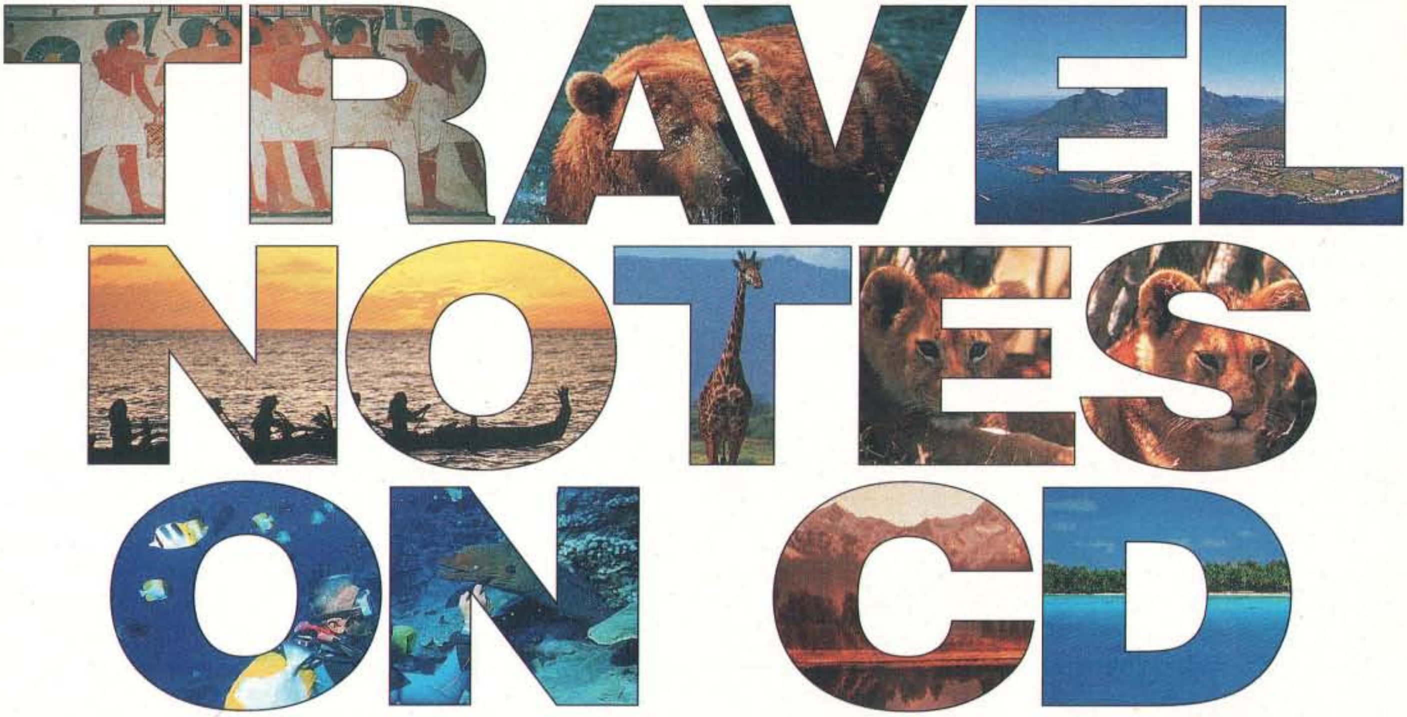
An even better answer is the Synaptics (San Jose, CA, (408) 434-0110) TouchPad. The TouchPad also takes advantage of capacitance-sensing technology, but the company has extended the pad's capabilities with proprietary algorithms for pattern recognition and adaptive analog VLSI technology. Not only does the TouchPad sense motion of any kind, it also senses pressure or even the distance of your fingertip from the pad's surface. Although not yet enabled through the current driver, this technology will support pressure-based functions such as handwriting, painting, and other applications that usually require a pressure-sensitive graphics tablet.


The Synaptics TouchPad (left) and the Alps GlidePoint.

To deal with the limitations of dragging, the TouchPad supports Edge Motion. When your finger reaches the edge of the pad's surface, the cursor continues to move in the indicated direction as you apply pressure to the edge of the pad. We used the Synaptics TouchPad on an Epson ActionNote (Torrance, CA, (800) 374-7300), and everything worked as advertised. Edge Motion removed one of the last major complaints about using touchpad technology and made the TouchPad a better choice than the GlidePoint. Your choice of pointing devices is still a personal decision, but touchpad technology just keeps getting better.

—Stanford Diehl

Don't just settle for collections of pictures!



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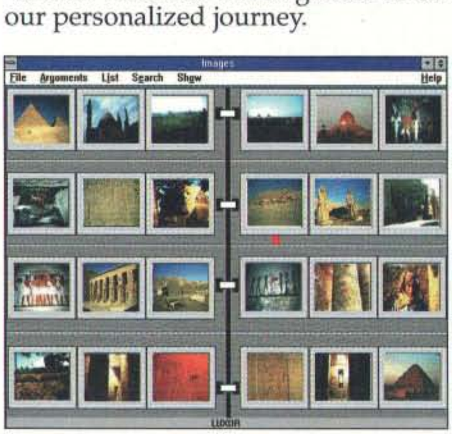

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Meridians with unretouched photos of active matrix displays.

ZEOS Meridian notebooks are the classiest acts in town, each the leader in its category, ready to give you the power, performance and mobility that you could only dream of until now!

While each Meridian product is distinct, they all have several intelligent features that set them apart including local bus video; an 84-key keyboard with a comfortable palm rest and integrated TruePoint™ pointing device; and the most solid construction available so that you won't be left smarting.

Meridian 400 Subnotebook

WINDOWS 1995 WIN 100 May 1995

"ZEOS is out to prove that good things do come in small packages with its Meridian 400C subnotebook," reported *Windows Magazine*.

At 3.9 pounds, the Meridian 400 is molded with a special carbon-fiber material that cuts weight and improves durability. And with a DX4-100MHz processor *standard*, it may well be the highest performance subnotebook available; "faster than a speeding desktop" is how *Computer Shopper* described it.

In addition to great performance, you also get hard drives to 350MB, RAM that's user upgradable to 20MB, two Type II PCMCIA slots, an external ultra-light 3.5" 1.44MB floppy drive (included in Packages 2 and 3) and your choice of active matrix or dual scan color screens. Amazing!

Meridian 800 Notebook

WINDOWS 1995 WIN 100 May 1995

"The 800C notebook offers sleek styling, solid construction and hot performance.... one of the fastest notebooks we've ever tested," said *Windows Magazine*.

At 6.3 pounds, the Meridian 800 full-size notebook is light enough to travel anywhere yet, with its whopping 10.3" dual scan or 9.5" active matrix color display, is large enough to use for presentations and everyday computing.

To complete the package, you also get a DX4-100MHz CPU, up to 20MB of user-upgradable RAM, a removable hard drive to 528MB, a built-in 3.5" 1.44MB floppy drive and PCMCIA slots supporting two Type II or one Type III devices. Full desktop features that fit in your briefcase!

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"On our Graphics Winmark 95 tests...ZEOS's Meridian 850C grabbed the top position. The ZEOS 850C again finished first on our Disk Winmark 95 tests," reported *PC Magazine*. Grade A+ for performance!

Imagine, today's most advance computing capabilities wrapped up in a 6.8 pound package. With features including your choice of Pentium® processors, a 256K synchronous SRAM cache, user-upgradable memory to 32MB, removable hard drives to 1.3GB, PCMCIA support for two Type

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No matter which Meridian notebook you purchase, you get the best service and support in the business! ZEOS has won seven *PC Magazine* Readers' Choice for Service & Reliability awards. And, ZEOS was the first to provide 24-hour toll-free technical support.

The ZEOS Meridian notebooks are a study in excellence. Their performance, quality, reliability and durability make them the class of the industry. And it's easy for you to get top honors, too. Just call your ZEOS Systems Consultant to order now at 800-554-5226. It's the smartest move you can make!

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Pentium® Processor		**850C**	**Pentium® Processor**		**850C**	**Pentium® Processor**		**850C**
75MHz		**$3295**	**75MHz**		CN! **$3795**	**75MHz**		CN! **$4195**
90MHz		**$3495**	**90MHz**		**$3995**	**90MHz**		**$4395**
➤ 8MB RAM, 256K synchronous SRAM cache ➤ 528MB DE hard drive ➤ Internal 3.5" 1.44MB floppy drive ➤ Integrated 16-bit stereo sound ➤ **MS Windows 95** or MS-DOS 6.2 & Windows for Workgroups 3.11 ➤ **MS Works 95** or MS Works			➤ 16MB RAM, 256K synchronous SRAM cache ➤ **810MB** IDE hard drive ➤ Internal 3.5" 1.44MB floppy drive ➤ Integrated 16-bit stereo sound ➤ Custom nylon carrying case ➤ Extra battery ➤ **MS Windows 95** or MS-DOS 6.2 & Windows for Workgroups 3.11 ➤ **MS Office Pro 95** or MS Office Pro			➤ 16MB RAM, 256K synchronous SRAM cache ➤ **1.3GB** IDE hard drive ➤ Internal 3.5" 1.44MB floppy drive ➤ Integrated 16-bit stereo sound ➤ External amplified speakers ➤ **14.4 PCMCIA fax/modem** ➤ Custom nylon carrying case ➤ Extra battery ➤ **MS Windows 95** or MS-DOS 6.2 & Windows for Workgroups 3.11 ➤ **MS Office Pro 95** or MS Office Pro		

Prices shown include dual scan color display.
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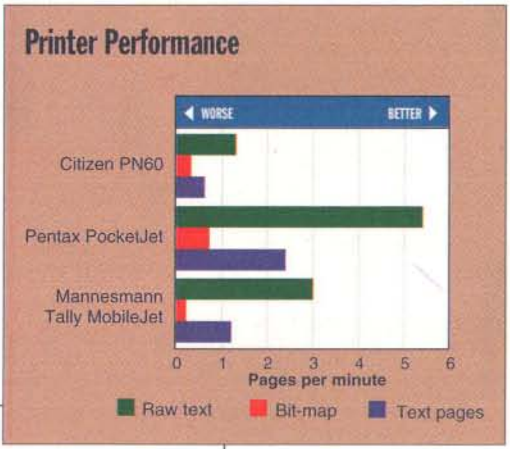
Printers to Go

We reviewed three portable printers that you can hook up to an ultraportable for a short print job if you're stuck in a hotel or an airport. These packable printers—the Mannesmann Tally (Kent, WA, (206) 251-5524) MobileJet ($350), the Pentax Technologies (Broomfield, CO, (303) 460-1600) PocketJet ($529), and the Citizen America (Santa Monica, CA, (310) 453-0614) PN60 ($399)—aren't built for speed or large-volume tasks, but they can get you out of a pinch if you need a hard copy of an invoice or a one-page document for an upcoming meeting.

Mannesmann Tally's MobileJet (4.6 pounds) is an ink-jet printer, and the smaller PocketJet (2.2 pounds) and PN60 (2.6 pounds) use variations of thermal-transfer technology to place ink on paper. The PocketJet is the most interesting because its direct thermal technology doesn't require ink cartridges, ribbons, or toner. The printer heats dye on special thermal paper supplied by Pentax. There is no toner to spill or inky ribbons to change, but the 8-cents-per-page cost of the paper can add up. The PN60 is the only one with color capabilities; its optional color print cartridge ($14.99 for a two-pack) replaces the printer's standard black-ink cartridge.

All three printers operate on both AC and battery power, and you can plug the MobileJet and the PN60 into a car's cigarette lighter with an optional adapter. The MobileJet is the most versatile printer because it doesn't require special paper and prints on envelopes, transparency film, and adhesive-backed labels. It is also the only one with a multiple-page feeder, so you don't have to feed the pages manually. The PocketJet pays a price for its unique printer technology: It doesn't print envelopes or adhesive-backed labels.



The PocketJet is the fastest printer on all but one of our printer performance tests. It prints at speeds of three text pages per minute with a maximum resolution of 300 dots per inch. The slim, rectangular PocketJet produces letter- and legal-size output and hooks up to your computer via a serial or parallel port. It has full Printer Control Language 4 (PCL4) LaserJet IIP compatibility and includes seven Hewlett-Packard internal fonts. Although the PocketJet is a single-sheet-feed printer, testers liked the way it goes back on-line when it's time to feed through the next sheet of paper.

PRINTERS AT A GLANCE

	PRICE	WEIGHT (LBS.)	MAX. RESOLUTION (DPI)
Mannesmann Tally MobileJet	$350	4.6	300
Pentax PocketJet	$529	2.2	300
Citizen PN60	$399	2.6	360

The PocketJet's rechargeable nicad battery supports 30 to 35 pages per charge and installs easily inside the printer's 11-inch-long chassis. The printer has three status indicators (power, data, and battery), and a density dial on the left side lets you set how dark or light you want the print job to be. The PocketJet produces quality text output and line drawings, but its output on our black-and-white photograph test was washy and unpresentable. However, its combination of speed and quality on text output makes it a good choice for those who need to print forms or invoices in a hurry.

Hook up to an ultraportable with the Mannesmann Tally MobileJet (upper left), the Citizen PN60 (middle), and the Pentax PocketJet.

The Mannesmann Tally MobileJet is the heftiest portable in the test-bed, but it offers more features than the other printers. The bubble ink-jet printer supports resolutions of up to 300 dpi, and its cut-sheet feeder can hold up to 15 pages. You can purchase optional nicad and nickel-metal-hydride (NiMH) battery packs, or you can load in 10 AA batteries to power the printer when a power conduit is not nearby. Ink cartridges are easy to install.

The MobileJet, which looks more like a desktop printer than the others do, is faster than the PN60 in our text performance tests, but it is the slowest printer in our font and graphics tests. Despite its slow performance, it prints a much crisper photographic image (although still kind of blotchy) than do the other two printers. It also prints better-quality output in our more graphically complex print-quality tests. The easy-to-use printer has a print speed of 2 pages per minute and a bidirectional parallel interface, and it is HP DeskJet Plus (PCL3+)–compatible.

The PN60 has a rectangular chassis similar to that of the PocketJet, and the thermal-transfer PN60 offers the highest-resolution setting at 360 dpi. It is the only printer available with an optional RS-422 serial interface for a Mac (it also has a standard parallel interface and an optional RS-232 serial interface). The printer has five built-in fonts and supports industry-standard IBM and Epson emulations.

The PN60 was the slowest printer we tested, taking about four times as long as the PocketJet to print the text and raw-text tests, but it was slightly faster than the MobileJet on the font and graphics tests. The PN60 received only a fair printer-quality rating, because it had trouble printing reverse type (black on white), and its output in the photograph test was an imperceptible blur of pixels. Testers also had some bones to pick with the PN60. They encountered frequent paper jams and found that you must manually guide the paper into the single-sheet feeder perfectly straight for it to catch. They also discovered that its tiny buttons are hard to push. Despite these criticisms, the PN60 is the only choice if you need to highlight documents with a splash of color.

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How We Tested

To pick the best ultraportables, we first ran a suite of tests using applications-based tests and NSTL's InterMark performance benchmarks to determine the fastest systems. We also measured their endurance with our Thumper II battery run-down tests, examined their screen quality, and decided which ones were easiest to use and had the most important features. The performance scores are weighted most heavily, followed by the screen-quality, battery-life, features, and usability scores.

PERFORMANCE

We assessed the performance of each ultraportable with a suite of applications-based and low-level InterMark tests. Prior to testing, we installed MS-DOS 6.2 and Microsoft Windows for Workgroups 3.11 onto formatted hard disks.

NSTL's Windows-based, low-level InterMark tests exercise the Windows Graphical Device Interface (GDI), as well as low-level graphics, CPU, FPU, memory, graphics, and the hard drive systems. The GDI component determines how well a system executes basic graphics calls within Windows. We ran all the Windows-based tests in 640- by 480-pixel resolution at 256 colors (except the Compaq Contura Aero 4/33C Model 250, which supports only 16 colors) using vendor-supplied graphics drivers. These applications benchmarks employ widely used programs, such as WordPerfect, FoxPro, and Excel, and thus gauge real-world performance.

FEATURES

We asked each vendor to complete a questionnaire to give us a detailed description of each system's features and support options. We then weighted each feature and calculated an overall features score (see the Roll Call on page 164).

We focused on three aspects of screen quality: crispness, intensity/color range, and viewing range. The screen-quality tests measure horizontal and vertical line placement, the color and gray-scale depths, and the frequency of LCD streaking. We used Sonera Technology's DisplayMate Professional 1.0 to analyze a wide range of display capabilities. To determine color quality, we displayed a color bar on each screen and assigned a score ranging from 1 (worst) to 5 (best). After plotting the viewing range using NSTL's Heads-Up Range Device (HURD), we computed the group's viewing-angle scores.

We measured battery performance with BYTE's Thumper II system. Thumper emulates a typical word processing session; robotic arms and optical sensors detect and control each system's power management scheme. Prior to testing, we completely drained and recharged each system's battery according to the manufacturer's instructions. We then configured each notebook's power management features to spin down the hard disk after 2 minutes of inactivity and shut off the backlighting after 1 minute. We let each system enter standby mode during the test cycle. At intervals, Thumper's robotic arms would wake up each system so that it would run until the battery died.

You must interpret the results of any battery-life test, including our own, with some caution. People use their ultraportables differently, which uniquely affects a system's battery life.

USABILITY

We also assessed the quality of each keyboard, concentrating specifically on key placement. We worked extensively with the ultraportables to see how comfortable they became after extended use, and we rated the response and feel of the keys. We also evaluated pointing devices for both right- and left-handed people and considered the usefulness of the LCD status indicators.

HOT CPU CHIPS KEEP THEIR COOL

There has always been a great compromise for users of portable systems: A faster (and hotter) CPU always meant shorter battery life. To end this trade-off, Intel has introduced 75- and 90-MHz Pentium processors specifically designed so that mobile systems perform better without compromising battery life.

The key to this paradox is Intel's Voltage Reduction Technology (VRT). It lets the Pentium processor operate at 3.3 V using off-the-shelf components, while its inner core operates at a cooler 2.9 V. This means that VRT-based Pentiums will consume as much as 30 percent less power than their desktop counterparts. The chips have a typical power dissipation of 2.5 to 3.5 W and idle power consumption of less than 1 W, according to Intel.

One of the first systems to debut with the Mobile 90 Pentium is Toshiba America Information Systems' Portégé 610CT (see the text box "The Incredible Shrinking Pentium" on page 148). By the time you read this, portable systems featuring the two new 2.9-V chips will be shipping from such leading vendors as AST Research, Compaq, Dell, Hewlett-Packard, and NEC.

The Intel Pentium: More power means less.

While Intel boasts that it will convert the entire notebook market to Pentiums by the end of this year, Cyrix has plans of its own. Cyrix showcased its mobile-slanted 5x86 CPU family last summer. According to Cyrix, it rivals 75-MHz Pentium performance. Power management features, which include System Management Mode (SMM), conserve power within the processor, as well as power flowing to peripherals.

One advantage of Cyrix's chip design that makes it attractive to vendors is that you can easily insert it into current 486 footprints. The chip will be in production in the fall, and many Taiwanese vendors (e.g., ASE, Chicony, Dataexpert, and Veridata) have shown preproduction 5x86-based notebooks. Epson plans to use the chip in upcoming portable and desktop systems.

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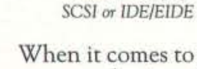
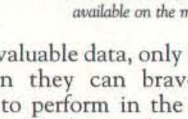
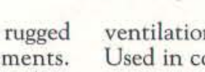


The DE100™ is a removable disk/tape subsystem that allows you to easily remove, transfer, and store data. It's compatible with an extensive variety of standard SCSI or IDE/EIDE drives.



With room for three 1" SCSI disk or tape drives, the DS300 model is the most compact removable storage subsystem available on the market today.



The DS500™ is an external rack mount that houses nine half-height bays, allows users to integrate any SCSI peripheral combination, and includes up to two 300-watt power supplies.

An ideal storage chassis for workstations, network servers, and PCs, the DS100 provides flexibility for users to mix and match up to four SCSI peripherals.

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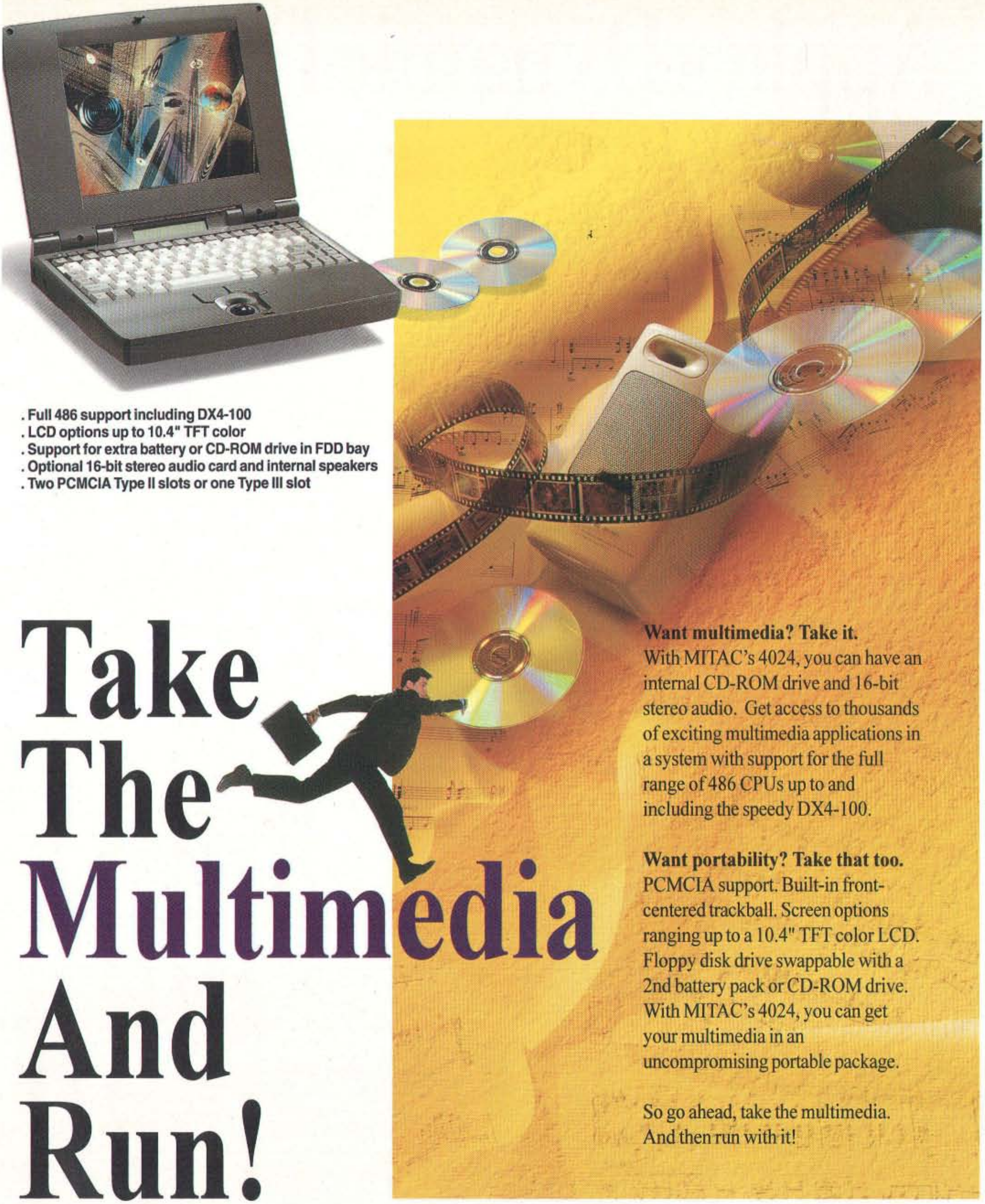

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Apple's Dynamic Duo

In August, Apple migrated its ultraportable computer line (called the PowerBook Duo) to the PowerPC processor. Recast as the PowerBook Duo 2300, it provides RISC power while holding the line on power consumption. It measures only 8.5 by 10.9 by 1.5 inches and tips the scales at only 4.8 pounds, making it a welcome addition to anyone's briefcase.

The Duo 2300 uses a PowerPC 603e, which has two 16-KB on-chip caches (one for data and one for code) and several power-saving modes. The processor can idle certain subsystems (e.g., the FPU or perhaps the data cache) when they're not in use. A single Type III nickel-metal-hydride (NiMH) battery provides an estimated 2 to 4 hours of battery life. Base system RAM is 8 MB, which is expandable to a maximum of 64 MB. Internal hard drives start at 750 MB and can be as large as 1.1 GB.

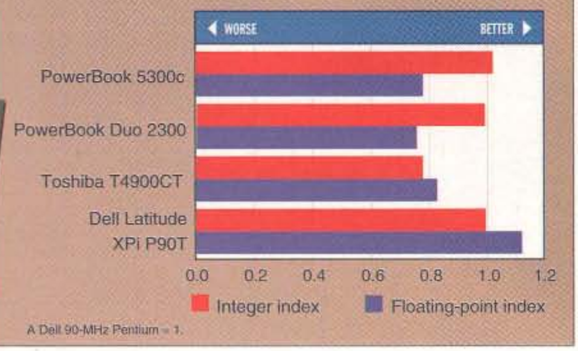
Apple's PowerBook Duo 2300c.

The Duo has a 9½-inch backlit active-matrix LCD screen that's a trifle small but readable. The engineering compromises made to achieve the Duo's slim form factor are a minimal set of I/O ports. It has a slot and an RJ-11 connector for an internal modem and a mini-DIN-8 serial connector that can function as a LocalTalk network port, printer port, or modem port, if required. Behind a hinged door lies a connector for plugging the computer into Apple's docking station, the Duo Dock. An optional small floppy docking unit can plug into this connector to provide ports for Apple Desktop Bus (ADB) and a floppy drive. This makes the computer more capable for stand-alone work but requires that you remember to pack the docking unit and the floppy drive.

The 603e's low power consumption, combined with Apple's power-conservation software, delivers long battery life. The BYTE battery-life tests showed that the Duo 2300 operated for 5½ hours. In terms of performance, the Duo 2300 weighs in with an integer BYTEmark of 0.986029 and a floating-point BYTEmark of 0.752184. Prices start at $3500 for a Duo 2300c with 8 MB of RAM, a 750-MB hard drive, and a 9½-inch active-matrix LCD screen.

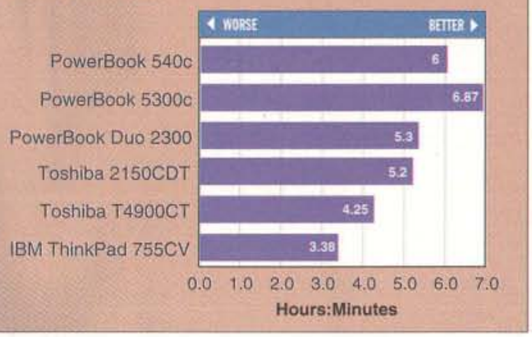
—Tom Thompson

PowerBook Performance



A Dell 90-MHz Pentium = 1.

Battery Duration



Product Information

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COLOR FOR THE ROAD

If you happen to be on the road with your trusty color PowerBook and you need to knock out a full-color document for a client, whom are you going to call? Now you can have your color files and print them, too, with Apple's Color StyleWriter 2200 (priced at $419). This portable color ink-jet printer prints at resolutions of 360 dots per inch and can accept plain paper, medium-weight labels, #6 and #10 envelopes, and transparency film. It measures in at just 2.2 by 11.8 by 6.2 inches and weighs in at just over 3 pounds (4.2 pounds with the battery attachment).

The printer takes only a few minutes to set up and consists mainly of clipping either a black- or color-ink cartridge into the print-head assembly. A storage case holds the ink cartridge when you travel with the printer. The printer connects to a PowerBook via a serial cable. Several floppy disks contain the printer-driver software and 19 additional TrueType fonts.

Printing speeds are determined by two factors. First, the more gutsy the PowerBook's processor is, the faster the driver generates the page image. For best appearances, you'll want to have your application generate page images at 144 dpi or better, which means more data must be shipped to the printer. This, in turn, slows the printing process. But the wait is worth it: Color output is gorgeous and rivals the output quality of the Hewlett-Packard 1200C ink-jet printer. —TT

For quality color in a portable package: the Apple Color StyleWriter 2200.

HONORABLE MENTIONS

Tired of fumbling around behind your desktop system for a serial port every time you have to transfer files to and from your desktop system and ultraportable?

The Gateway 2000 Liberty DX4-100 Deluxe, the IBM ThinkPad 701C, and the Hewlett-Packard OmniBook 600CT have infrared ports and accompanying software for wireless data transfer. You point the Irda-compliant ports on these advanced ultraportables to an infrared module connected to the desktop to exchange files, or to an infrared-capable printer to print documents.

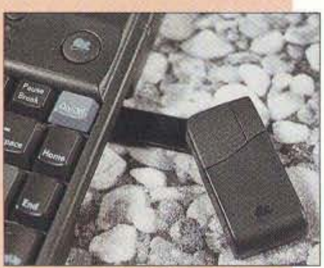
The ThinkPad 701C comes with an expansion unit (it attaches to the back of the system) called the MultiPort II, which has eight ports for a serial device, a parallel device, audio input and output devices, a keyboard, a mouse/numeric keypad, a power port, and an external display. The module weighs less than one-half pound, and you can leave it home if you don't anticipate attaching external devices during your jaunt.

Digital Equipment put a lot of thought into the trackball on its HiNote Ultra CT475. The left-click mouse button wraps almost entirely around the trackball, while the seldom-used right-click button is just a sliver above the trackball.

Dubious Achievements

On the two Austin ultraportables, the Sceptre TS37 Subnotebook, and **Gateway's Liberty**, you have to pull the external floppy drive off the parallel port if you want to connect a parallel-attached network adapter, printer, or external CD-ROM drive. The Compaq Contura Aero 4/33C Model 250 uses its PC Card (formerly PCMCIA) slot for its external floppy drive, which occupies a valuable expansion slot. The other ultraportables have ports dedicated for their external floppy drives.

Hewlett-Packard's OmniBook 600CT gets one of the best usability ratings, but its mouse that pops out the side of the system is really annoying. The mouse attaches to the ultraportable via a plastic leash that not only proved restrictive when moving the cursor but also felt like it would break off with a quick jerk.



PRIMAX'S COLORMOBILE OFFICE

So you've picked your ultraportable and portable printer. What's left? How about a color scanner for the road that can handle almost any scan job. Primax Electronics' (Campbell, CA, (800) 338-3693 or (408) 364-2800) ColorMobile Office ($289) features a modular design so that you can snap on attachments for hand-held, sheet-fed, and self-motorized scanning of images and documents.

The ColorMobile Office weighs only 2 pounds and supports any image mode from black-and-white up to 24-bit true color at resolutions ranging from 100 to 400 dots per inch. The ColorMobile Office working alone as a hand-held scanner can scan pages from a book or manual. If you have shaky hands, the Motor Module attachment rolls the scanner along a flat trackpad for up to A4-size documents. The Office Feeder sheet-fed module sucks in 4-inch-wide business cards or photographs.

The scanner is bundled with the TWAIN-compatible ImagePals Go file management and image-editing software. It also includes ReadIris Intelligent Text Recognition OCR software to edit scanned-in text files. ColorMobile Office works on AC power and hooks up to a system via the parallel port.

Primax's ColorMobile Office lets you scan documents while in transit.

Zinc-Air Batteries Last All Day

In portable computing, no technology seems to be changing more rapidly than that of batteries. Today, nicad batteries are being eclipsed by nickel-metal-hydride (NiMH) and lithium-ion cells. On the horizon, however, are zinc-air batteries that can power a laptop for between 10 and 15 hours.

AER Energy Resources ((404) 433-2127) has developed zinc-air batteries (priced at $399) for portable systems from Toshiba, Hewlett-Packard, and Zenith that can last an entire workday. Zinc-air cells, which store 150 watt-hours of energy, have two to three times more gravimetric energy than nicad and NiMH batteries, but the batteries are boxy and bulky at about 4 pounds. These batteries use oxygen from the air to support reactions that generate electricity, and they need more airflow than other batteries.

Besides the benefit of longer running time, zinc-air batteries lack the memory effect found in nicad batteries, so you can recharge them anytime rather than waiting until the battery is totally drained. The batteries, however, endure only 25 to 50 recharge cycles, but according to AER representatives, you get 200 to 400 hours of total run time from a zinc-air battery, which is about the same as with nicad and NiMH batteries that have 200 to 300 recharge cycles.

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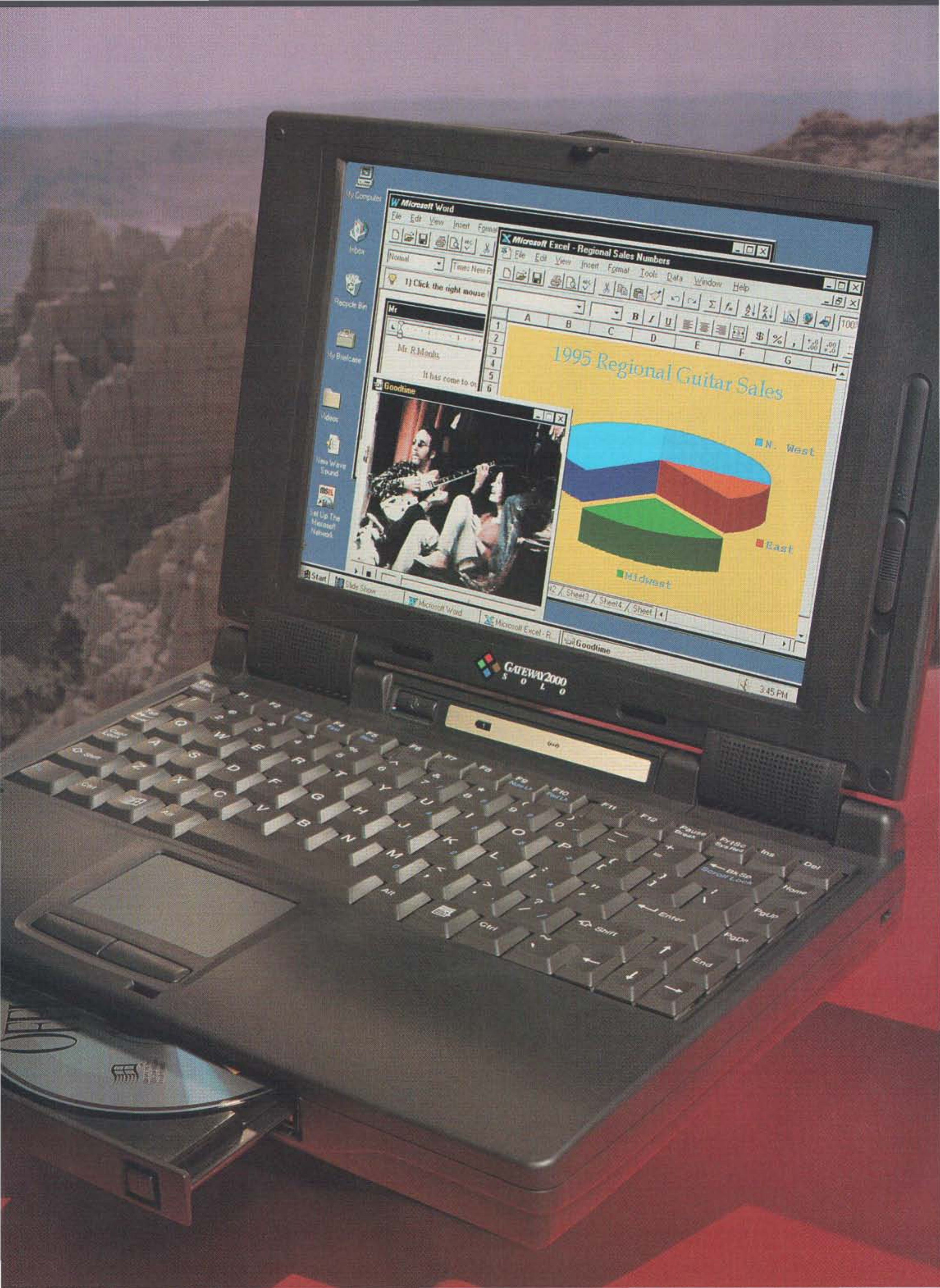
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Price as tested	$2223	$2065	$2407	$1199
Performance rating	5.6	4.6	6.1	3.4
Features/ease of use	7.9/7.7	7.1/7.8	7.2/7.8	6.2/6.6
Screen quality	7.3	7.0	6.2	2.7
Battery life (hr:min:sec) as tested	3:52:28	2:52:15	3:18:33	4:22:47
Traveling weight (lbs.)[2]	6.1	6.4	6.6	5.7
MICROPROCESSOR				
CPU/MHz	486DX4/75	486DX2/50	486DX4/75	486SX/33
Voltage	3.3	5.0	3.3	5.0
SYSTEM RAM				
RAM as tested/max. RAM (MB)	8/20	8/20	12/20	8/20
Memory speed (ns)	70	70	70	70
Memory architecture	Noninterleaved	Fast-paged	Fast-paged	Paged
SYSTEM BIOS				
BIOS vendor	SystemSoft	Phoenix	Phoenix	Compaq
Flash ROM upgradable	●	●	●	●
System ROM BIOS shadowing	●	●	●	●
Video ROM BIOS shadowing	●	●	●	●
VIDEO				
Screen manufacturer	Sharp	Sharp	Sharp	N/A
Graphics accelerator manufacturer/model	Chips & Technologies 65535	ACC 2066NT	ACC 2066NT	N/A
Diagonal screen size (inches)	10.4	9.5	9.5	7.8
Display technology	Passive-matrix	Passive-matrix	Passive-matrix	Passive-matrix
Max. display resolution (pixels)/total colors	640x480/256	640x480/256	640x480/256	640x480/16
Graphics memory as tested/bus width (bits)	512-KB DRAM/32	512-KB DRAM/32	512-KB DRAM/32	512-KB DRAM/16
External VGA display support	●	●	●	●
Max. ext. display resolution (pixels)/total colors	1024x768/16 million	1024x768/256	1024x768/256	640x480/16
Simultaneous int. and ext. display/key-activated toggle for display selection	●/●	●/●	●/●	○/●
BATTERY				
Battery type	NiMH	NiMH	NiMH	NiMH
Supports multiple battery packs/hot swapping	○/●	○/○	○/○	○/○
MASS STORAGE AND FLOPPY DRIVES				
Hard drive manufacturer and model	Toshiba MK1824FCV	Toshiba MK1824FCV	Toshiba MK1924FCV	Compaq 250
Hard drive interface type/average access time (ms)	IDE/13	IDE/13	IDE/13	IDE/17
Hard drive controller cache (KB)	128	128	128	None
Hard drive formatted capacity/largest available (MB)	340/540	335/810	517/810	250/250
Removable hard drive	●	●	●	○
Standard 3½-inch floppy drive	Internal	External	External	External
I/O PORTS (BUILT IN)				
Number of nine-pin serial ports	1	1	1	1
Number of 25-pin serial ports	N/A	1	1	N/A
UART type	16550	16550	16550	16550
Centronics parallel port	Bidirectional	EPP	EPP	EPP
Pointing device	Trackball	Trackball	Trackball	Trackball
External keyboard port	●	●	●	○
Type II/Type III	N/A/1	N/A/1	N/A/1	1/N/A
Other I/O ports	N/A	N/A	N/A	N/A
SOUND				
Integrated sound	○	○	○	○
Built-in microphone	N/A	N/A	N/A	N/A
Ext. microphone port	N/A	N/A	N/A	N/A
Ext. speaker port	N/A	N/A	N/A	N/A
Volume control	N/A	N/A	N/A	N/A
ADDITIONAL FEATURES				
Embedded/overlaid numeric keypad	●	●	●	●
Wattage	24.0	30.4	30.4	10.0
Switchable voltage	●	●	●	○
SOFTWARE				
DOS disks included	●	●	●	○
Microsoft Windows 3.1 disks included	●	○	○	○
Microsoft Windows for Workgroups disks included	○	●	●	○
Other	AT&T Mail Access Plus, OAG FlightDisk, AT&T Vistium, Share, CompuServe, GEnie, Prodigy, WinComm Lite	Microsoft Office Standard 4.2	Microsoft Office Standard 4.2	TabWorks, WinLink Transfer Uti and Lotus Organizer
MISCELLANEOUS				
14.4-Kbps fax modem	N/A	N/A	N/A	N/A
External battery charger (for secondary battery)	Included	Optional	Optional	Optional
Additional battery	Optional	Optional	Optional	Optional
Standard warranty length (years)/coverage	1/P, L, R	1/P, L	1/P, L	3/P, L, F, R
VENDOR INFORMATION				
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Phone	(513) 445-5000	(512) 339-3500	(512) 339-3500	Call local Compaq dealer.
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● = yes; ○ = no; N/A = not applicable.

[1] Not SL-enhanced.

[2] The traveling weight includes the system and its components, such as a floppy drive, adapters, and a battery pack.

[3] One optional extra Type III in expansion dock.

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7.8/7.9	8.4/7.8	6.3/8.3	8.0/8.1	7.0/7.7	7.1/8.0	7.1/8.0
10.0	3.6	8.1	8.2	3.0	9.9	6.4
4:39:55	4:15:12	5:46:10	2:08:32	3:31:48	2:29:49	2:20:39
5.6	6.1	5.8	6.4	6.4	6.0	6.0
486DX4/75	486DX4/100	486DX4/75	486DX4/75	486SX/33	486DX4/100	486DX4/100
3.3	3.3	3.3	3.3	5.0	3.3	3.3
8/24	24/24	8/32	8/24	8/12	8/20	8/20
70	70	70	70	70	70	70
Interleaved	Paged	Paged	Paged	Interleaved	Fast-paged	Fast-paged
SystemSoft	SystemSoft	Phoenix	IBM PC Co.	SystemSoft	Phoenix	Phoenix
●	●	●	●	●	●	●
●	●	●	●	●	●	●
●	●	●	●	○	●	●
Toshiba	Sharp	Toshiba	Sharp	Sharp	Toshiba	Toshiba
Chips & Technologies 65545	Chips & Technologies 65545	Chips & Technologies 65545	Chips & Technologies 65545	Chips & Technologies 65540	Cirrus 6440	Cirrus 6440
9.5	10.4	9.5	10.4	9.5	7.9	7.9
Active-matrix	Dual-scan	Active-matrix	Active-matrix	Dual-scan	Active-matrix	Dual-scan
640x480/256	640x480/256	640x480/65,536	640x480/256	640x480/256	640x480/256	640x480/256
1-MB VRAM/32	1-MB DRAM/32	1-MB DRAM/32	1-MB DRAM/32	512-KB DRAM/16	1-MB DRAM/32	1-MB DRAM/32
●	●	●	●	●	●	●
1024x768/16 million	1024x768/256	1024x768/65,536	1024x768/16 million	1024x768/256	1024x768/256	1024x768/256
●/●	●/●	●/○	●/●	●/●	●/●	●/●
Lithium-ion	Lithium-ion	Lithium-ion	Nicad (optional NiMH)	NiMH	NiMH	NiMH
○/○	○/●	○/○	○/●	○/●	○/○	○/○
Toshiba MK1824FCV	IBM DBOA-2720	Integral Viper 260	IBM DBOA-2360	Hitachi DK221A34	Areal A340	Areal A340
IDE/12	IDE/13	PC Card ATA/16	IDE/13	IDE/12	IDE/12.3	IDE/12.3
256	N/A	32	64	64	32	32
528/528	720/720	260/260	540/720	250/820	350/350	350/350
○	●	●	○	●	○	○
External	External	External	External	External	External	External
1	1	1	1	1	1	1
1	1	N/A	N/A	N/A	N/A	N/A
16550	16550	16550	16550	8250	16550	16550
EPP	EPP	Bidirectional	EPP	Unidirectional	Bidirectional	Bidirectional
Trackball	EZ Point Integrated Pointer	Pop-out mouse	TrackPoint III	Trackball	TruePoint	TruePoint
●	●	○	●	●	●	●
N/A/1[3]	None/1	N/A/1	N/A/1	1/None	2/None	2/None
N/A	N/A	Infrared	Irda, audio I/O, headphone, speaker, and microphone	N/A	N/A	N/A
●	○	●	●	○	○	○
○	N/A	●	●	N/A	○	○
●	N/A	●	●	N/A	○	○
●	N/A	●	●	N/A	○	○
●	N/A	●	●	N/A	●	●
●	●	●	●	●	●	●
30.0	35.0	40.0	30.0	25.7	37.0	37.0
●	●	●	●	●	●	●
○	●	○	●	●	●	●
○	○	○	○	●	○	○
○	●	○	●	○	●	●
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N/A	Included	N/A	Included	N/A	Included	Included
Optional	Optional	Optional	N/A	Optional	N/A	N/A
Optional	Included	Optional	Optional	Optional	Included	Included
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Is There a GLINT in Your Future?

A close look at a coprocessor that accelerates 3-D graphics

**TREVOR MARSHALL
AND JOHN DAVEY**

Both the Pentium and the PowerPC deliver sufficient horsepower to display 3-D images on desktop computers. But as powerful as these processors are, to offer real-time support of 3-D imagery, they require an assist from dedicated hardware.

The GLINT chip from 3Dlabs is the most mature of all the chips, from several manufacturers, that will bring true 3-D graphics display capabilities to the desktop over the next few years. These chips won't produce images like you see in Hollywood films because they use a technique called Gouraud shading instead of the more photorealistic ray-tracing mechanism. But they do produce images that can move fast enough to fool the eye into the illusion of three dimensions.

In this article, we will explain how the GLINT 300SX chip connects to external hardware and how a GLINT board produces fast real-time 3-D displays. We will also look at a few features that 3Dlabs added to the chip to make 3-D displays really sizzle.

3-D Display Basics

A lot of hardware and software technology goes into producing a 3-D graphics display system. Chips such as the GLINT 300SX can produce 300,000 Gouraud-shaded triangles per second, but very few software packages are currently capable of driving them to this capacity. Even a 120-MHz Pentium processor with a fast PCI bus connected to the GLINT is capable of generating only about 200,000 triangles per second.

Several factors limit the speed of 3-D operations. A lot of information has to be passed over the bus. It takes 29 32-bit parameters to describe each of the two shaded triangles that make up a polygon. This translates into a sustained data rate of 10 MBps, which is impractical over an ISA bus and even difficult for the PCI bus (see "Fast Transit," October 1992 BYTE). The applications software itself also has to keep track of an extra dimension of parameters, which places a further load on the CPU. So a ton of thought has been put into ways in which the graphics processor can reduce the computing load on the host CPU.

The GLINT not only handles multiple display windows (so only part of a screen needs updating between frames), it also keeps track of Z-buffer data (used to plot only those objects in the "front" of the image). In addition, the chip manages the alpha blending (transparency); fogging (which enhances the illusion of depth); copying (which moves a cube of 3-D data, not just a 2-D image plane); and dithering (a technique for interpolating colors to make surfaces look smoother).

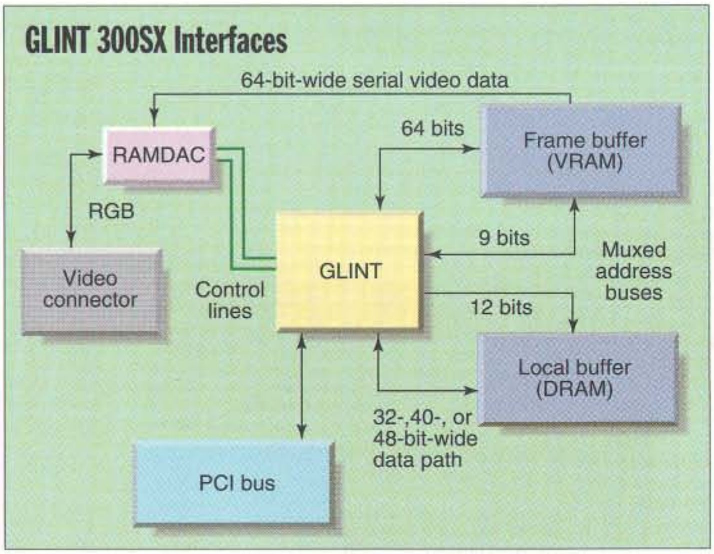
To do all this, GLINT uses two memory systems: a VRAM frame buffer that contains the actual pixel information, and a DRAM-based local buffer that contains the Z-buffer, alpha blending, and other 3-D housekeeping bits associated with each pixel in the display buffer.

Why So Many Pins?

The GLINT chip comes in a 304-pin package. It's a gate array made for 3Dlabs by IBM Microelectronics, and it looks similar to IBM's PowerPC 601 CPU. The size of the silicon die, however, is larger than that of the 601, and it has more transistors. One of the reasons there aren't too many good 3-D graphics display chips available is that, as the die size indicates, they tend to be pretty complex beasts. Luckily, despite its internal complexity, the GLINT hardware interface makes it really quite simple to integrate into a display system design.

As the figure "GLINT 300SX Interfaces" shows, in a typical GLINT display system, the chip can simultaneously access data from the PCI bus, a 64-bit-wide VRAM frame buffer memory, and a 48-bit-wide DRAM local buffer. Pins are also required to handle the VRAM and DRAM address buses.

The GLINT connects directly to the PCI bus, which


GLINT 300SX Interfaces

The GLINT as a video controller in a PCI-bus display board. Little glue logic is required to connect the chip to the PCI and RAM buses.

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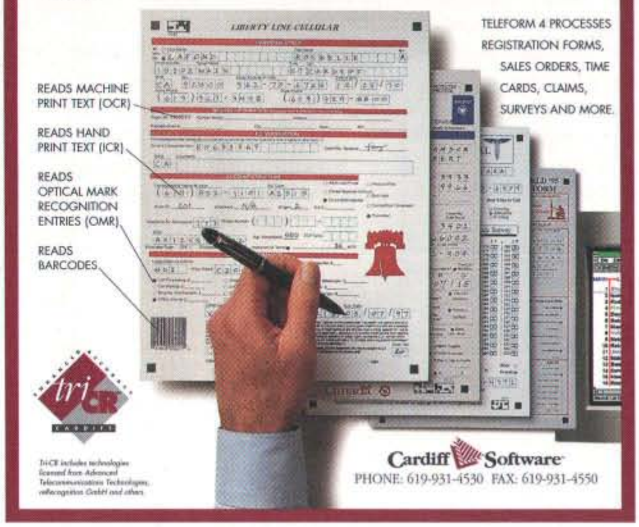

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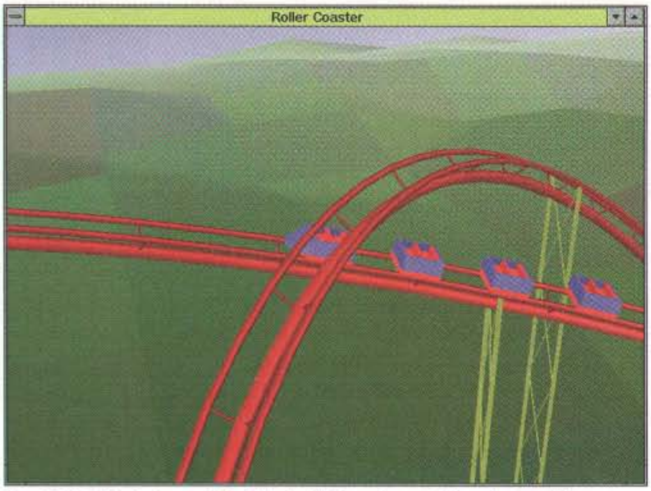

The GLINT displaying a 3-D object with fogging, which enhances the illusion of depth.

eliminates the glue logic normally required to communicate to the bus. This also reduces a graphics board's component count and cost. The GLINT has an internally set PCI manufacturer's ID of 0x3d3d (clever—3Dlabs) and supports all the signals and registers defined in the PCI 2.0 standard. It has internal DMA, which allows either command or data blocks to be burst over the bus at around 20 MBps. This capability is important—without burst mode, you can get a data rate of only 3 to 8 MBps on a PCI bus.

Connecting VRAM and DRAM to the GLINT is very easy indeed. The address bus is internally multiplexed, so you can just connect the GLINT address pin through a damping resistor to the address lines on the memory. The control and data lines connect in the same way. Again, no glue logic is necessary.

When the GLINT powers up, it senses the state of some of the data lines (which are pulled either up or down by resistors) and configures its internal logic to address the amount of RAM present. It also automatically sizes the data bus widths (bus widths of 32, 48, or 64 bits are supported, depending on whether you're addressing DRAM or VRAM). This lets you customize the display system for the exact features you need. Once you've considered a few control lines and redundant power and ground lines, all 304 pins have been accounted for.

The VRAM has another 64-bit data bus, which passes the serial pixel data to a RAMDAC. The latter component assembles the 64-bit stream into pixels of different sizes. These 64-bit chunks of data can be modified to produce eight 8-bit (256 colors) pixels, four 16-bit (thousands of colors) pixels, or two 24-bit (millions of colors) pixels, as determined by the RAMDAC's display mode. This pixel bus operates at a maximum speed of 150 megapixels per second.

Having all these separate buses gives the GLINT massive processing power and throughput. It can be receiving a PCI command, writing a new pixel to the VRAM, and reading mask and Z-buffer information from the local DRAM, all during the same system cycle. It would not be possible to do these operations all at once with a general-purpose CPU, like the PowerPC 601, which handles only one 64-bit data access at a time.

Video Features

As important as throughput is to a display's performance, for 3-D imagery, additional image-processing capabilities are crucial for fast screen drawing. The GLINT provides hardware support

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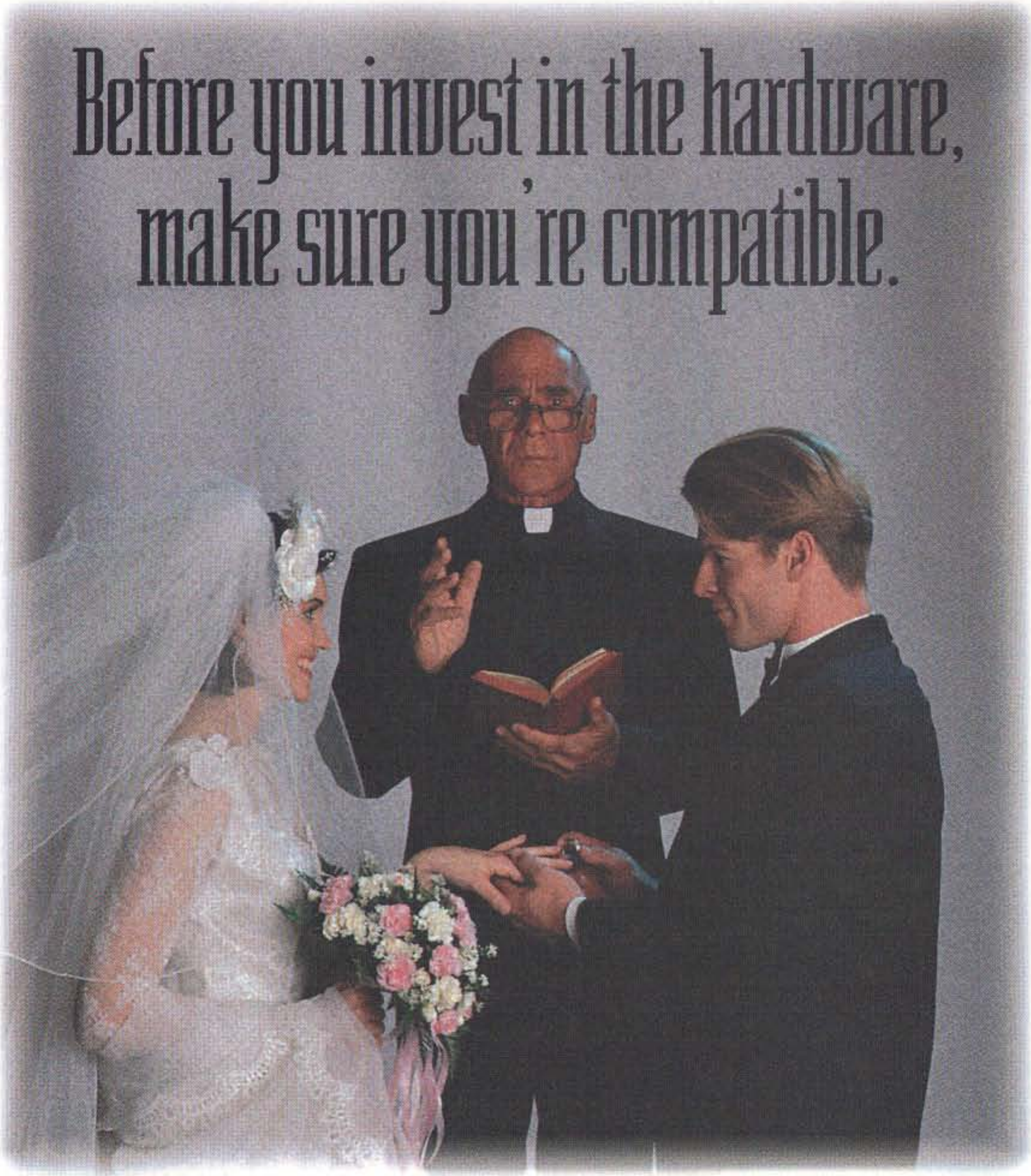

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in a number of areas. Three worth mentioning in detail are antialiasing, color dithering, and screen-buffer clearing.

Antialiasing: This important graphics operation helps convince the eye that an image appears "real" and not computer-generated. When the display system draws a diagonal line, it does so by illuminating a set of pixels on the screen. The pixels in this line appear as discrete steps, particularly at the transition (or boundaries) between screen pixels. Antialiasing adds extra pixels to the line, which smoothes out these sharp boundaries.

The GLINT chip does this automatically by calculating the correct color and position for each pixel so that such boundary effects are minimized. The host software tells the GLINT to draw a line in 3-D space, and the GLINT draws it with depth perception and automatic antialiasing characteristics. This allows the applications software to operate purely in a fast vector-drawing mode. The screen at left shows a typical 3-D vector program whose output has been enhanced using the built-in antialiasing and fogging effects.

Color dithering: When it is shading a surface, the GLINT calculates all the pixels with 32-bit accuracy. Only at the end of the pipeline does it convert them to the 24-, 16-, or 8-bit color display modes. A dithering unit at the end of the graphics pipeline takes the 32-bit color value and tries to display it so that, even if only 256 colors are available on-screen, the eye interpolates between the different colored pixels and perceives an intermediate color value. The GLINT does this interpolation inside a 4- by 4-pixel matrix (16 pixels) with no speed penalty at all. Surprisingly, it works very well, assisted by the additional pixel-averaging effect of the shadow mask apertures on your CRT.

Clearing the screen buffer: The frame buffer VRAM has a built-in "fast clear" hardware mode that allows it to be cleared very quickly indeed. But in a 3-D graphics display system, it is also important to clear all the Z-buffer and alpha information in the DRAM local buffer.

However, DRAM does not have a fast-clear hardware capability. To clear it, you typically have to write a new value to every memory cell. This is not practical to do at the typical 30 frames per second necessary to achieve smooth motion in a 3-D display environment. So the GLINT Z-buffer has a feature called "fast clear."

Instead of clearing the entire Z-buffer on every frame, the GLINT divides the screen into 16 or 256 segments that get cleared only on sequential frames. The GLINT keeps track of which segments have been cleared, and if you are drawing into a section that hasn't been cleared recently, it uses a cleared pixel value when calculating the new Z-buffer value. Tag bits, kept in the local buffer DRAM memory, indicate whether or not a segment has been cleared.

The Future Is 3-D, but Faster

The GLINT is the first of a series of 3-D graphics controllers to come to market. While other manufacturers are producing similar chips that are less expensive, 3Dlabs is concentrating on building display controllers that define the state of the art for desktop graphics systems. Future versions of the GLINT chip will be able to directly handle texture mapping, and no doubt they'll run faster. ■

Trevor Marshall, a consulting editor for BYTE, is chairman of YARC Systems. John Davey is a project engineer at YARC Systems who has worked on a GLINT display board. They can be reached on the Internet at trevor@yarc.com and john@yarc.com, respectively.

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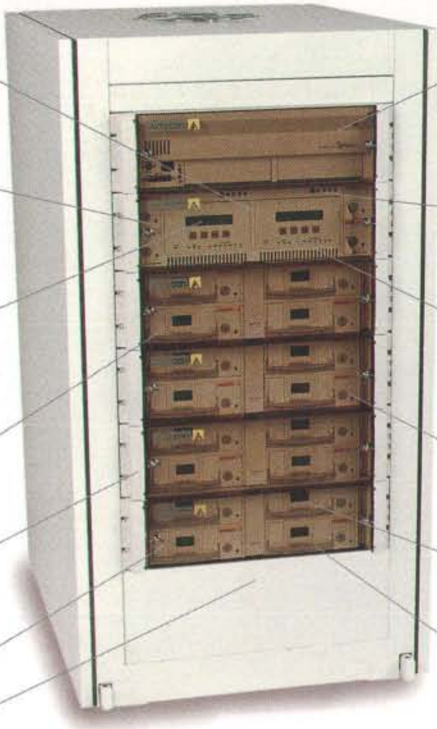

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Weaving a Thread

Solaris and Windows NT both support powerful multithreading/multiprocessing to help get the job done faster

SHASHI PRASAD

A symmetric multiprocessor (SMP), also called a shared-memory multiprocessor, has multiple CPUs sharing a common memory space. This memory sharing allows a single copy of the OS to be running on all the processors. SMP machines promise higher performance and better scalability, but the OS software must be designed to support multiprocessing and also be tuned for a scalable and efficient SMP. The OS, by means of some application programming interface (API), should allow the application developer to split his or her program into multiple pieces and run them simultaneously.

Loose Threads

A sequential process has a single flow of control, a sequence of instructions executed by the process. In a multithreaded process, there are multiple schedulable flows of control called threads. Threads are associated with a sequence of instructions and are often referred to as "threads of execution." Threads support the notion of concurrent programming and are used to exploit the inherent hardware parallelism of the SMP machine. By splitting a problem into smaller pieces, a thread can run each piece concurrently on an SMP machine.

Traditionally, applications were split into multiple processes, and some form of interprocess communications (IPC) was used to communicate between the processes. A multithreaded process has more than one thread of control sharing both address space and resources. Using threads eliminates the need for any IPC and reduces context-switching overhead. Threads are also referred to as lightweight processes (LWPs), since the context maintained for threads is much lighter than processes. Even though threads are schedulable entities, it does not necessarily mean that they run in parallel. Threads can be scheduled concurrently on multiple processors, while on uniprocessor machines, threads are time-sliced.

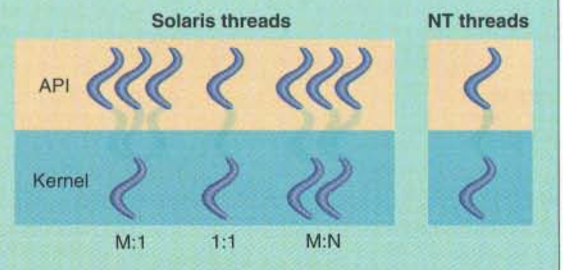
With Solaris 2.2, Sun introduced a threads library for applications developers to take advantage of the multiprocessing and multithreading features of the advanced kernel. Solaris uses a two-tier thread library model. At the top layer are the user threads, and at the bottom layer are LWPs.

LWPs are kernel threads—they use kernel resources and are the actual schedulable entities in Solaris. The kernel is aware only of LWPs and knows nothing about user threads. The user threads are managed by the threads library, which supports one-to-one, many-to-many, or many-to-one mapping between the user threads and the LWPs (see the figure "Thread Mapping in Solaris and NT" below). The multiplexing of user threads to a pool of LWPs and the scheduling of user threads is handled by the threads library. Though the two-tier thread model adds some extra responsibility onto the user application, it allows for the cheap creation of user threads without using a lot of system resources.

Solaris has bound and unbound user threads. A bound thread is a one-to-one mapping between a user thread and an LWP. An unbound thread does not have a dedicated LWP; the threads library schedules the user thread on a pool of LWPs in a process. Applications that require global scheduling with respect to other LWPs in the system should use bound threads.

LWPs are scheduled by the kernel according to their scheduling class and priority. In Solaris, the process is created with an initial LWP, which inherits the scheduling class and priority of the parent process. Bound threads inherit the scheduling class and priority of the underlying LWP, while unbound threads inherit the scheduling class and priority of the process.

Thread Mapping in Solaris and NT



Solaris's various API-to-kernel thread mappings is flexible, but NT's direct mapping is simpler.

The Solaris kernel employs a preemptive priority-based scheduling system. LWPs of higher priority run before LWPs of lower priority. The Solaris threads library schedules user threads using priority levels on a pool of LWPs and chooses an LWP to execute user threads that are ready to run. If the LWP is blocked on an indefinite wait, the library saves the context of the blocked thread and assigns another thread to the LWP to run. The threads library usually creates enough LWPs to ensure that the process can proceed without an indefinite wait.

A Different Approach

Microsoft Windows NT was designed from the ground up to support multiprocessing and multithreading. Borrowing from the ideas of object-oriented design, Windows NT uses object classes to represent the system resources. In NT, both processes and threads are represented as objects. Threads are the schedulable entities in NT; every process in NT must have at least one thread before it can execute. Unlike the Solaris two-tier thread model, NT uses a straightforward one-to-one mapping between a user thread object and a kernel thread object.

Threads have 32 different priority levels and are broadly classified into two classes: real-time and variable. Real-time threads in NT are always scheduled ahead of other threads in the system, and the NT kernel does not alter the priority of real-time threads. The thread dispatcher uses a preemptive priority scheduler, with the highest priority thread always scheduled to run.

Threads in the variable class have a base and a dynamic priority. The base priority of a thread ranges two levels above and below the process base priority. The kernel periodically adjusts a thread's dynamic priority. For example, when a thread waits on an I/O, the kernel raises the dynamic priority of that thread. Threads that are CPU-bound tend to have lower dynamic priorities, while I/O-bound threads tend to have higher dynamic priority. A thread's dynamic priority can never fall below the thread's base priority.

Thread Comparison

	Solaris	NT
Thread model	Two-tier	Direct
Posix thread API support	No (planned for 2.5)	No
Re-entrant OS libraries (i.e., thread-safe)	Yes (except for Motif/OpenLook)	Yes

Each process has a processor affinity, a set of processors on which the threads of that process can run. Processor affinity affects thread scheduling. The NT kernel first picks the highest priority thread and then determines if the thread can run on the processor. If it can't, the next highest priority thread on the processor is chosen to execute. NT, like Solaris, employs soft processor affinity such that it always tries to schedule a thread on the processor on which it last ran.

Threads API

In addition to the SMP OSes, both systems provide an API for creating and using threads in an application. Solaris's threads API is based on the Unix International threads interface, and support for the Posix threads interface is planned in the upcoming release of Solaris 2.5. The Solaris threads interface is very similar to the Posix interface, and applications developed using the threads API on Solaris can be easily ported to use the Posix interface. Windows NT does not support the Posix interface, and applications use the Win32 interface to develop multithreaded applications.

Any threads API can be broadly classified into such groups as thread management, thread synchronization, and thread-specific data. In both Solaris and NT, an initial thread is created when the process starts execution. Additional threads of control must be created by calling the thread-creation API. When a thread is created, it begins executing a start routine, and the new thread of control within the process is capable of independently being scheduled in both Solaris and Windows NT. Each newly created thread has its own stack, program counter, and a thread identifier. Thread identifiers in Windows NT are unique system-wide, while in Solaris they are guaranteed to be unique only within the context of the executing process.

Threads in a process exist in the same address space and share all the process resources, such as data variables, open file descriptors, and object handles. The sharing of data can be a blessing in disguise. Consider two threads in a multiprocessing environment concurrently updating a linked list. The results of such operations are undefined and can lead to data corruption. In a multithreaded program, any data that multiple threads can update simultaneously must be synchronized. Both Solaris and NT provide several thread-synchronization primitives.

Solaris and NT provide mutual exclusion, or mutex locks, to manage critical sections of the code. These mutex locks allow only one thread to execute the critical section of the code.

In multithreaded applications, it is common to divide the work between multiple threads. In such cases, one thread might have to wait for another thread to reach a particular state before proceeding. This form of synchronization is often called event synchronization. Solaris provides condition variables, while NT provides event objects for interthread synchronization.

In addition to mutexes and condition variables, Solaris provides semaphores and reader/writer locks for thread synchronization. Some of the other synchronization primitives in NT are critical section objects, semaphores, and I/O completion ports. The synchronization APIs on NT offer better functionality than those on Solaris and, except for critical section objects, provide the same APIs for process and thread synchronization. Though both OSes provide the basic functions for thread programming, the Posix threads interface provides much more advanced features than does the Win32 interface.

Developing multithreaded applications also requires an environment that supports multithreading. Solaris provides re-entrant versions for most of the commonly used libraries. Currently, Solaris does not provide thread-safe versions for Motif and OpenLook libraries, which are rarely used by multiple threads in a program. Windows NT also provides re-entrant versions for most of its commonly used libraries.

Debugging multithreaded applications is a big challenge and could be frustrating without the support of a thread-aware debugger. Solaris supports a multithreaded debugger as a part of SPARCworks/iMPact, while Microsoft supports a multithreaded NT debugger as part of Visual C++. In addition to showing all threads of a process, both debuggers support suspending and resuming threads and inspecting variables on a per-thread basis.

The structured exception-handling (SEH) feature of Windows NT aids in the development of robust multithreaded applications. Terminating threads can always release held resources before exiting on exceptions, thus avoiding indefinite postponement. The exception-handling features of Windows NT are not language-specific.

Multithreaded Future

Solaris and Windows NT provide good environments for the development of multithreaded applications. They are by no means the only multithreaded OSes available at the desktop. NextStep, AIX (and other Unixes), and OS/2 provide thread support, as does Windows 95. Future versions of the Macintosh OS will also go threaded. The increasing availability of multiprocessor hardware and the improved responsiveness realized even on uniprocessor machines means multithreaded applications are here to stay. ■

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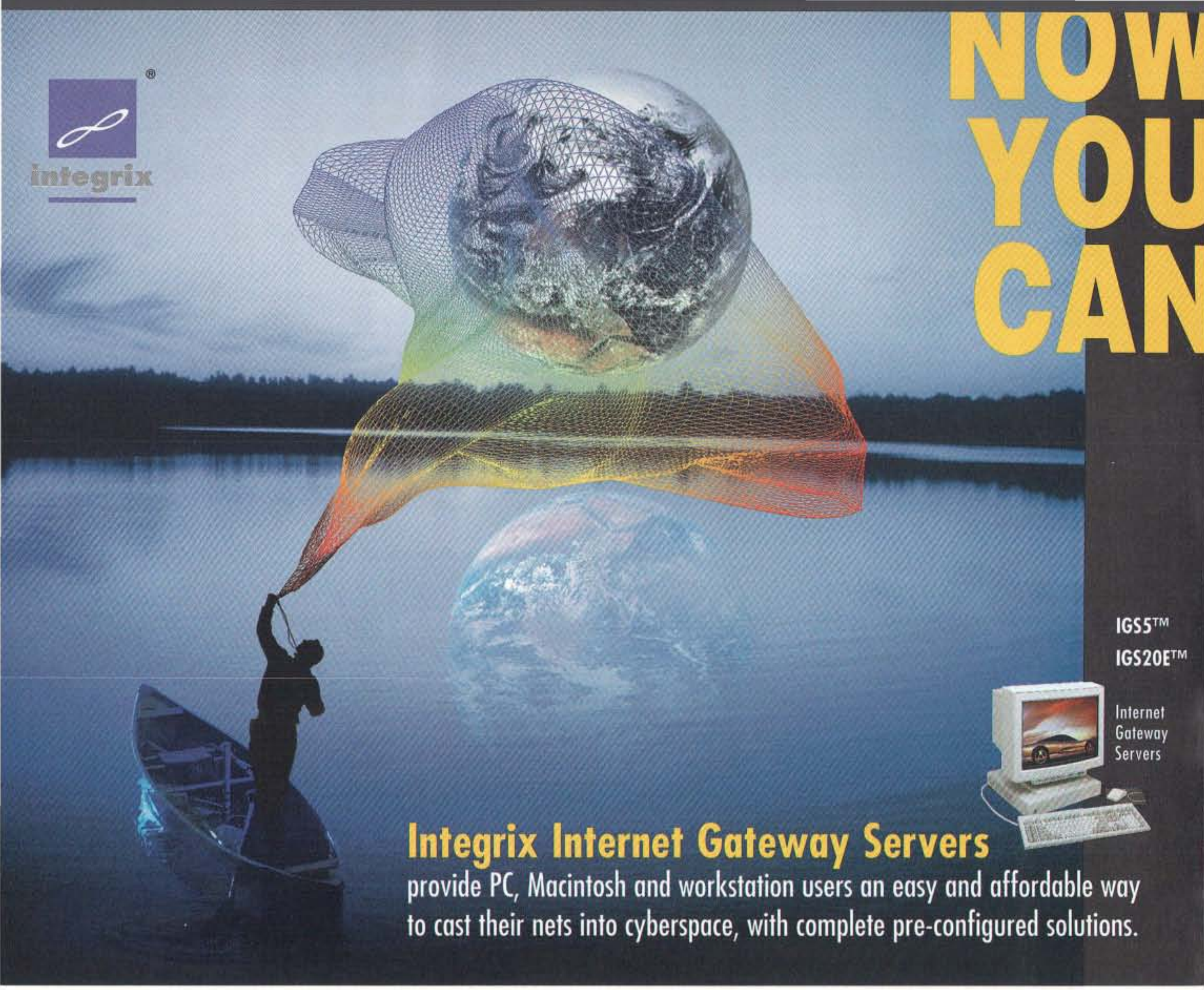
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The Standard Template Library

Part of the draft C++ standard, STL provides the framework for building generic, highly reusable algorithms and data structures

ALEXANDER STEPANOV

In every programming language, there's a need for various data structures, such as vectors, lists, and associative arrays. Programmers also need fundamental algorithms—for sorting, searching, and copying—defined for the data structures. It has long been lamented that C++ doesn't provide a good set of standard data structures.

But at last this problem has been remedied. The Standard Template Library is a framework of data structures (called *containers* in STL) and algorithms accepted as part of the draft C++ standard. A reference implementation of STL has been put into the public domain by Hewlett-Packard (it can be downloaded from butler.hpl.hp.com), and a growing number of commercial vendors are now shipping STL.

In the short time since its release, STL has generated many emotional—and conflicting—assessments. On one hand, for example, Bjarne Stroustrup of Bell Laboratories calls it a "large, systematic, clean, formally sound, comprehensible, elegant, and efficient framework." On the other hand, Pamela Seymour of Leiden University writes that "STL looks like the machine language macro library of an anally retentive assembly language programmer."

Goal: Generality + Efficiency

STL is not an attempt to impose yet another standard on a suffering humanity. And it was not designed by or for a committee. It is the result of over 15 years of research in generic programming that I've done in different places, with different collaborators, and in different programming languages. I did this research with a concrete goal in mind: to find a way to write algorithms in the most general way, but in such a way that their abstractness would not impose any performance penalty.

What do I mean by "in the most general way"? Simply that an algorithm works on all data types for which it makes sense. For example, a linear-search algorithm is written in the most general way if it can search any data structure for which the operations of looking at data, going to the next data element, and indicating the end of the search range are defined. So, it should work for an array, a singly linked list, a doubly linked list, a file, and even a binary tree.

An algorithm should also work for portions of such structures. For example, you might want to search half a list or sum the set of elements in an array that are *n* spaces apart (i.e., a stride).

What do I mean when I say that an algorithm does not "impose any performance penalty"? In other words, how do you know that a generic algorithm is efficient? An algorithm is called *relatively efficient* if it's as efficient as a nongeneric version written in the same language, and it's called *absolutely efficient* if it's as efficient as a nongeneric assembly language version.

For many years, I tried to achieve relative efficiency in more advanced languages (e.g., Ada and Scheme) but failed. My generic versions of even simple algorithms were not able to compete with built-in primitives. But in C++ I was finally able to not only accomplish relative efficiency but come very close to the more ambitious goal of absolute efficiency. To verify this, I spent countless hours looking at the assembly code generated by different compilers on different architectures.

I found that efficiency and generality were *not* mutually exclusive. In fact, quite the reverse is true. If a component is not efficient enough, it usually means that it's not abstract enough. This is because efficiency and abstractness both require a clean, orthogonal design. A similar phenomenon occurs in mathematics: Making a proof more abstract makes it more concise and elegant.

Orthogonal Component Space

The past 25 years have seen attempts to revolutionize programming by reducing all programs to a single conceptual primitive. Functional programming, for example, made everything into a function; the notions of states, addresses, and side effects were taboo. Then, with the advent of object-oriented programming (OOP), functions became taboo; everything became an object (with a state).

STL is heavily influenced by both functional programming and OOP. But it's not a single-paradigm library; rather, it's a library for general-purpose programming of von Neumann computers.

STL is based on an orthogonal decomposition of component space. For example, an array and a binary search should not be reduced to a single, fundamental notion.

Printing Names of Productive Employees

```
vector<Employee> all;
bool is_manager(const Employee& x) {
        return x.title == "manager"  }
...
remove_copy_if(
  all.begin(),
  all.end(),
  ostream_iterator<Employee>(cout),
  is_manager);
```

The two are quite different. An *array* is a data structure—a component that holds data. A *binary search* is an algorithm—a component that performs a computation on data stored in a data structure. As long as a data structure provides an adequate access method, you can use the binary-search algorithm on it. Only by respecting the fundamental differences of arrays and binary searches can efficiency and elegance be simultaneously achieved.

Iterators

The key to STL is the notion of *iterators*, which are generalized pointers that provide a glue for connecting algorithms and data structures. STL is indeed retrograde in its disregard of the current academic dogma suggesting that pointers are evil. Instead of hiding pointers behind value semantics, it makes them the cornerstone of the design. The decision to bring pointers back into the realm of respectability was based on a simple fact: Most things in programming resemble pointers in that they identify a location of data. For instance, Internet addresses, SCSI addresses, and file descriptors all function as pointers.

An STL Implementation of remove_copy_if( )

```
template <class InputIterator, class OutputIterator, class Predicate>
OutputIterator remove_copy_if(InputIterator first, InputIterator last,
                              OutputIterator result, Predicate pred)  {
   while (first != last)  {
       if (!prod(*first)) *result++ = *first;
       ++ first;  }
   return result;  }
```

Consider the task of printing a list of productive employees (see the listing "Printing Names of Productive Employees"on page 177). The employees' names are stored in a *vector*, an STL version of a one-dimensional dynamic array. To print the names of productive employees, you use the STL function `remove_copy_if()`, which scans the range of elements from its first argument up to, but not including, its second argument and copies those that do not satisfy a predicate (its fourth argument) into positions starting from its third argument. (For most people, the code is clearer than the explanation.) The functions `begin()` and `end()` return iterators pointing to the first element and past the last element in the vector, respectively. (STL requires that for every container, the number of valid iterators pointing to it is one greater than the number of elements in the container.) The STL component `ostream_iterator` provides an iterator-like interface to an output stream.

It's important to note that if you later decide to put employees' names in a list instead of in a vector, you do not have to change anything except the declaration of the variable `all`. The `remove_copy_if()` function works for vectors, lists, deques, and sets (which are all STL components), as well as for any user-defined container that provides STL-conforming iterators. It also works for regular C arrays.

Iterator Categories

STL classifies iterators into five categories: input, output, forward, bidirectional, and random-access. These iterator categories are sets of requirements for operations that are supported by concrete iterator types. An important experimental discovery I made was that hundreds of different practical algorithms can be written in terms of these abstract categories.

STL specifies a set of valid expressions for each category's iterators, as well as precise semantics for each iterator's usage. For example, given that `i` is a value of a type that belongs to a bidirectional iterator category, if ++i is defined, then `--(++i) == i`. STL also prescribes certain complexity requirements for these expressions. Users are thereby guaranteed that algorithms written in terms of these abstract interfaces will work effectively.

Different algorithms require different kinds of iterators, and different algorithms are needed to perform different operations on different data structures. STL uses a novel language technique that selects the right algorithm at compile time, depending on the iterator category.

Generic Algorithms

The listing "An STL Implementation of `remove_copy_if()`" illustrates how STL deals with iterators. What's most striking is the fact that it looks just like regular C code; only the signature is different. In fact, I've found that C programmers find it quite easy to start programming in STL even when they don't know C++, because the underlying idioms are already familiar to them. The fact that all the iterator categories are abstracted from pointers ensures that there is an efficient implementation for them.

In computer science it's important to base abstractions on efficient models. In other words, I believe that `remove_copy_if()` is efficient because it generates good code when used with plain C arrays. In fact, if you use `remove_copy_if()` with STL function objects rather than with pointers to functions, as I did in the listing "Printing Names of Productive Employees," you can obtain code that is often just as efficient as hand-written assembly code.

The Future

It is my hope that STL will prove to be the beginning of a long process of developing systematic catalogs of highly parameterized software components. The ANSI/ISO C++ standard committee saw the promise of STL and provided a conduit through which generic programming could reach working programmers.

I'd like to use this opportunity to advocate the creation of an industrywide consortium for developing new generic components. No single company can accumulate the algorithmic expertise that is needed for such an activity. And it is in everybody's interest that all the fundamental algorithms and data structures be universally and inexpensively available. ■

ACKNOWLEDGMENTS

I would like to express my gratitude to Bjarne Stroustrup, Ross Towle, Jim Dehnert, Suresh Srinivas, Mary Loomis, and Larry Rosler for reviewing this article.

Alexander Stepanov is a member of the technical staff at Silicon Graphics, Inc. (Mountain View, CA), where he works on C++ libraries and tools. Prior to joining SGI, he worked for HP Labs, AT&T Bell Labs, Polytechnic University (Brooklyn, NY), and GE R&D. He has worked in such areas as generic software libraries, storage systems, OSes, compilers, and path-planning algorithms for robots. He can be contacted on the Internet at stepanov@mti.sgi.com or on BIX c/o "editors."

Internet Firewalls

The demand for good Internet firewalls is spurred by the growing number of intrusion incidents

STEPHEN COBB

With new connections to the Internet appearing at the rate of 1 million per month, internetworking may be the biggest revolution in computing since personal computers. But changes of this magnitude often create problems. It's no secret that the rate at which Internet connections are being hacked, cracked, or otherwise compromised is also growing at an alarming rate.

That has caused many companies to look to Internet firewall technology to protect their network resources. However, many companies, when searching for solutions, are finding that they are stymied by a lack of common definitions for key firewall functions. This makes it difficult to tell what functions you are paying for and makes comparisons of similar products impossible.

The National Computer Security Association (NCSA), an independent security association, is trying to bring some order to the confusion created by marketing hype. The NCSA has formed a group called the Firewall Product Developers' (FWPD) consortium. It brings together leading vendors of firewall products in an effort to address such common issues as customer education, standards, product testing, research, and certification.

The FWPD consortium is similar in structure to the Anti-Virus Product Developers' (AVPD) consortium, which was founded by the NCSA in 1991. That group, which included virtually all the major antivirus product vendors, helped clear up the confusion in the antivirus market. For example, the AVPD consortium agreed to use a common naming scheme for viruses. All vendors counted the number of viruses their products detected in the same way, letting customers easily compare products. The FWPD consortium seeks to do the same thing for firewalls.

Meeting a Need

The demand for good Internet firewalls is spurred by the growing number of intrusion incidents. The number of violations reported to the Computer Emergency Response Team (CERT) in 1990 was 130. That number increased to 2300 in 1994.

People involved in these incidents are not just kids getting their kicks with modems. Systematic and automated probing of new Internet connections is being carried out by a shady cast of characters that includes hackers-for-hire, information brokers, and foreign governments. Katherine Hutchison, director of secure business for Harris Computer Systems, points out that computer crackers gained unauthorized access through the Internet in more than 80 percent of the computer crimes investigated by the FBI.

Fortunately, network administrators can avail themselves of some effective countermeasures, notably firewalls. A firewall can be defined as a collection of systems, routers, and policy placed at a site's central connection to a network. This definition comes from the paper "Keeping Your Site Comfortably Secure," an excellent introduction to Internet firewalls from the National Institute of Standards and Technology (NIST Special Publication 800-10). It can be downloaded free of charge from the NIST World Wide Web site (http://www.nist.gov), as well as from sources such as the NCSA InfoSecurity Forum on CompuServe (type GO NCSA to get to the forum).

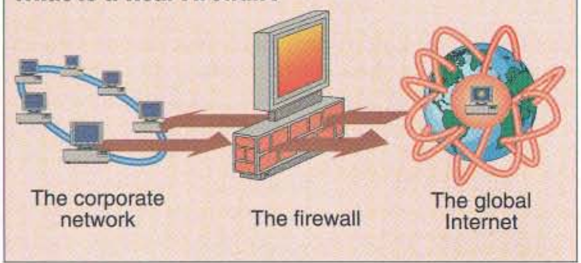
According to Rich Kosinski, president of Internet Security (Lexington, MA), a firewall is a form of access-control technology that prevents unauthorized access to information resources by placing a barrier between an organization's network and an unsecured network (see the figure "What Is a Real Firewall?"). You can also use a firewall to prevent the unauthorized export of proprietary information from a corporate network. In other words, a firewall functions as a gateway, controlling traffic in both directions.

The Firewall Dilemma

Firewalls have been called condoms for corporate networks. They provide digital protection for participants in the packet-level intercourse associated with the rapid growth of internetworking and commercialization of the Internet. As with condoms, many people have heard of firewalls, and some people use them. However, the number of security incidents arising from Internet connections strongly suggests that not enough people are using them properly.

continued

What Is a Real Firewall?



The Firewall Product Developers' consortium is working toward a common language that will let users better understand and compare firewall implementations.

MEMBERS OF THE FIREWALL PRODUCT DEVELOPERS' CONSORTIUM

(For information about each organization's efforts, send E-mail to the address listed.)

ANS CO+RE Systems, Inc.	interlock@ans.net
Atlantic Systems Group	sales@asg.com
CheckPoint Software Technologies	shlomo@CheckPoint.com
Digital Equipment Corp.	kaiden@ljo.dec.com
Harris Computer Systems Corp.	Cyberguard@mail.hcsc.com
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Network Systems	pjjpayack@network.com
Raptor Systems	smcconnon@raptor.com
Telos	michael.lazar@telos.com
Trusted Information Systems	gauntlet-info@tis.com

You might think this is a no-brainer: If you can't make a safe connection to the Internet without a firewall, you get one or you don't connect. But both of these options are fraught with problems. The current level of information-superhighway hype is so intense that network managers who don't provide users with Internet services are likely to find users doing it for themselves.

"Users buy a $100 modem with petty cash, plug it into a PC on the network, and, since our machines are already running TCP/IP, just turn on SLIP or PPP and dial out to a local service provider," says one network manager (who preferred to remain anonymous) at a major automobile plant. "What these users don't realize is, they have just made the company network part of the Internet."

If you decide to take the preferred approach, an officially sanctioned and properly managed Internet connection, you will find that installing a firewall is several orders of complexity beyond plugging in a modem or configuring NetWare directory access rights. For a start, you have to decide whether to build your own firewall (perhaps using a router and one of the available toolkits), buy an off-the-shelf product, or budget for a specialized firewall consultancy.

Next, you have to decide what type of firewall you want. Do you want a packet filtering router, a dual-homed gateway, a screened or bastion host, or a screened subnetwork? Do you want to integrate a modem pool while you're at it? Are you going to run the firewall software on Unix or under Windows NT? What sort of access controls will you place on the host to prevent internal tampering with the firewall settings?

Where to Find

For more information about the Firewall Product Developers' consortium, contact:

National Computer Security Association
10 South Courthouse Ave.
Carlisle, PA 17013
(800) 488-4595
(717) 258-1816
firewall@ncsa.com

When you look at the current offerings in the marketplace, you see a wide range of prices, from tens of thousands of dollars down to a few hundred dollars. You may wonder what could possibly make the top-end product worth so much more than the bottom-end product. This is where customer education is critical. Most vendors will gladly supply you with white papers and briefings, point you to Web sites, and otherwise assist you in understanding their product.

However, you may well discover that one vendor's definitions are not consistent with another's. That can cause much confusion. In fact, the lack of a standard terminology with which to describe this rapidly evolving technology means that you will probably have difficulty reaching the decisions required to successfully implement a firewall, causing further delays.

Unfortunately, the lack of a common vocabulary, combined with the urgent need for protection, is being exploited by unscrupulous vendors. Some vendors have slapped the word *firewall* on products that do not measure up to the NIST definition given earlier. If a firewall is not installed properly, it could be worse than not having one due to a false sense of security.

Some Relief in Sight

This is where the FWPD consortium comes in. It was formed in June by a group of vendors and several security agencies (see the table). The FWPD wants to foster codes of practice for the industry. "The FWPD will promote awareness and understanding of firewalls, explore product certification and testing, and serve as an authoritative but independent contact point for inquiries about firewall technology," says Peter Tippett, president of the NCSA.

Tippett describes the public information role as countering the media hype and being the voice of calm. To provide the necessary depth of knowledge in firewall technology, the NCSA has formed a strategic partnership with Marcus Ranum. Head of Information Works, Ranum is well known for his seminal 1992 paper "Thinking About Firewalls." Ranum also designed the TIS Internet Firewall Toolkit, which forms the basis of more than a dozen commercial products.

Noting that many firewall product descriptions use similar jargon in dissimilar ways, Ranum proposed, and the inaugural meeting of the FWPD agreed, that the first order of business should be to develop a common language for talking about firewalls. As a starting point, Ranum presented a draft version of the Firewall Product Functional Summary, a standardized format in which vendors can describe the distinguishing features and advantages of their products. The Summary's second major purpose is to give users a way to compare and contrast the features and design principles of firewall products.

The goal of the Firewall Product Functional Summary is to provide plenty of scope for vendors to present the strengths and advantages of their particular offerings, but in a way that has some real meaning to users. The document can be accessed via the Web at http://iwi.com or by sending an E-mail message to firewall@ncsa.com.

Beyond Standards

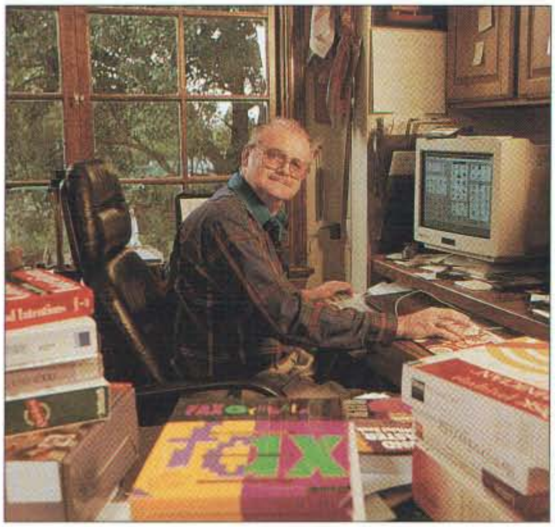
The FWPD is not "yet another standards committee," says Bob Bales, executive director of the NCSA. Noting that the industry already has appropriate committees, such as ANSI, for setting standards in areas such as firewall-to-firewall encryption, Bales says that the goals of the FWPD are more in the direction of customer education and industry self-regulation.

"The bottom line is getting more people to use more firewalls more effectively," says Bales. The formation of the FWPD means that the people who need firewalls and the people who make them will be able to work together more effectively to better defend the network systems upon which we all increasingly rely. ■

The author of more than 20 books and hundreds of articles on computing, Stephen Cobb is director of special projects for the NCSA and cochair of the Computer Ethics and Responsibilities Campaign. His latest book, The NCSA Guide to PC and LAN Security, *will be published by McGraw-Hill later this year. He can be contacted at scobb@ncsa.com.*

JERRY POURNELLE

Death Swoops and Upgrades



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From a spacecraft to hardware and software upgrades, Dr. Pournelle's explorations into the unknown continue on all frontiers

I'm just back from watching the DC/X do a perfect death swoop, and maybe I'd better explain that. The DC/X is a one-third scale model of a single-stage-to-orbit (SSTO) spacecraft. Back in 1989, Max Hunter, General Daniel Graham, and I convinced the National Space Council to investigate the SSTO concept, and the DC/X was one result. If you see it fly, it's unforgettable: it goes straight up, hovers, and lands on a tail of fire.

One design for a full-size SSTO spacecraft reenters nose first, meaning that somewhere in the flight it must rotate to tail down. That's a dangerous maneuver that's become known as the death swoop, but yesterday's flight went so well it was almost dull.

There was one glitch. The radar altimeter gave a false reading, and the flight-control software, which thinks this is a very odd F-15 flying an even odder flight profile, believed the reading. Thus, the ship came down fast and landed harder than she was supposed to, crushing some nonresilient shock-absorbing material. That's what's supposed to happen in a hard landing, and the crushables are designed to be field-replaceable, so you can count this another successful test.

Meanwhile, we've been upgrading both hardware and software at Chaos Manor. As usual, things didn't go quite as planned, so we learned a lot.

The first upgrade was installing OS/2 Warp Connect on Valiant, the ValuePoint Pentium. Installing OS/2 has been so difficult that I expected more trouble with Warp Connect than I had. Still, I had enough problems that I kept IBM technical experts Sam Detweiler and Charlie Brown on the phone for 3 hours.

IBM has been listening: OS/2 Warp Connect's installation program is a lot better than previous OS/2 installation programs. Installing it on Percy, the IBM PS/2 Model 77, went without a hitch. Percy had been running Blue Label Warp, meaning that it has Win-OS/2 built in. Alas, Valiant was running Red Label Warp—which requires your own DOS and Windows—and OS/2 Warp Connect is Blue Label. An additional problem was that I was using OS/2 LAN Server with the older Warp. You can't install Warp Connect over that. Fortunately, it uninstalls itself easily.

Before it was over, I learned more about editing an OS/2 CONFIG.SYS file than I wanted. Although I was talking to system programmers, standard IBM technical support is quite good. If you're determined to get Warp Connect installed, they'll work with you until you manage it. One detail is significant: when you do get it installed, turn off your computer before you bring it up for the last time.

When you get OS/2 Warp Connect running, you'll like it. It retains one major design defect. Whereas Windows and Windows 95 (W95) trap Ctrl-Alt-Del and let you use that to shut down a nonresponding window, all flavors of OS/2 commit suicide when receiving Ctrl-Alt-Del. While it's rare to get an application so fouled up that Ctrl-Escape won't return to the OS/2 desktop, it can happen with both DOS and Windows programs running in an OS/2 environment. It's most

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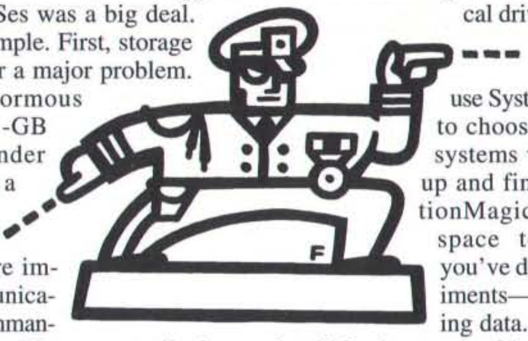
likely when testing new software. It's extremely likely if you run a DOS game inside Windows inside OS/2. Also, I can reliably crash OS/2 by being careless with the reply editor in Norton Commander's MCI Mail Manager.

With that exception, I've found OS/2 Warp Connect as solid as a rock. It's fast. It networks to itself, Windows for Workgroups, and W95 with no problems. It does reliable multitasking. It prints so well that I've connected the Hewlett-Packard LaserJet III to Valiant and do all my printing across the network. The package includes an astonishing amount of useful and solid software, including communications software that makes Internet surfing almost trivially simple.

OS/2 is neat. Why not try it? A year ago, that would have been an insane suggestion: changing OSes was a big deal. Now it's fairly simple. First, storage space is no longer a major problem. You can buy enormous hard drives—a 1-GB IDE drive is under $300, and we got a 3-GB SCSI drive for under $800. Second, and more important,V Communications' System Commander lets you change OSes more easily than you used to be able to change CONFIG.SYS and AUTOEXEC.BAT.



System Commander is a blooming miracle. It's simple to install, and once installed, it's easy to add OSes. The instructions are complete, and the documents are a decent guide to configuring OSes.

You install System Commander under DOS. If you're putting it on an OS/2 machine, you dual-boot back to DOS and install it there, after which System Commander will operate exactly as OS/2 Boot Manager, whether you installed Boot Manager or not. Once you have System Commander installed, you can add OSes to your heart's content. I'm seriously thinking of setting up a machine with Blue and Red Label Warp; DOS 3.x, 5.x, and 6.x; Novell DOS 7; NT; W95; Linux; and SCO Unix. That may be going a bit far, but it's possible.

Some installations can be a bit tricky, and you'll want to read the documents carefully. For instance, if you already have W95 installed, you must save some files in a temporary place, boot up with a DOS disk, install System Commander, reboot W95, reboot from a DOS disk, SYS the hard disk with DOS, and reboot one more time. At this point, you'll have your choice of booting with DOS or W95. You can then add other OSes.

Highly recommended for anyone who likes to experiment.

PowerQuest's PartitionMagic works with System Commander, and it's recommended in the System Commander manual. While System Commander lets you change OSes without reformatting and losing your data, PartitionMagic lets you decide how much of your hard drive you want to devote to each OS. You can change those allocations on the fly. If you want to experiment with OS/2's High Performance File System (HPFS), this is a painless way to try it.

The version I have says "For OS/2," but in fact it includes a version that runs just fine under DOS. You can use DOS PartitionMagic to create a new logical drive for OS/2 and other OSes. You can then use System Commander to choose among those systems when you boot up and finally use PartitionMagic to reallocate space to them after you've done your experiments—all without losing data. Of course, you should back up everything before trying this.

Installing and using PartitionMagic is easy, and the instructions are clear and complete. If you get System Commander, you'll almost certainly want this, too. Highly recommended.

Before you upgrade, you must back up your system. You should know about SnapBack, which may be the ultimate in backup programs.

My regular backup system remains Palindrome's Network Archivist with a digital audiotape (DAT) drive. I have used it for years both locally and over a network, and I have never lost a byte of data protected by it.

Network Archivist is great for recovering lost files, and its library management guards against operator errors. I wouldn't want to be without it; but using it to restore whole volumes can be complicated, and it doesn't do anything to restore the boot sectors of an OS.

For that you need SnapBack, which builds up a "below-the-OS" low-level image of any drive or drive partition. That image can contain as much of the original data as you like and can be stored on

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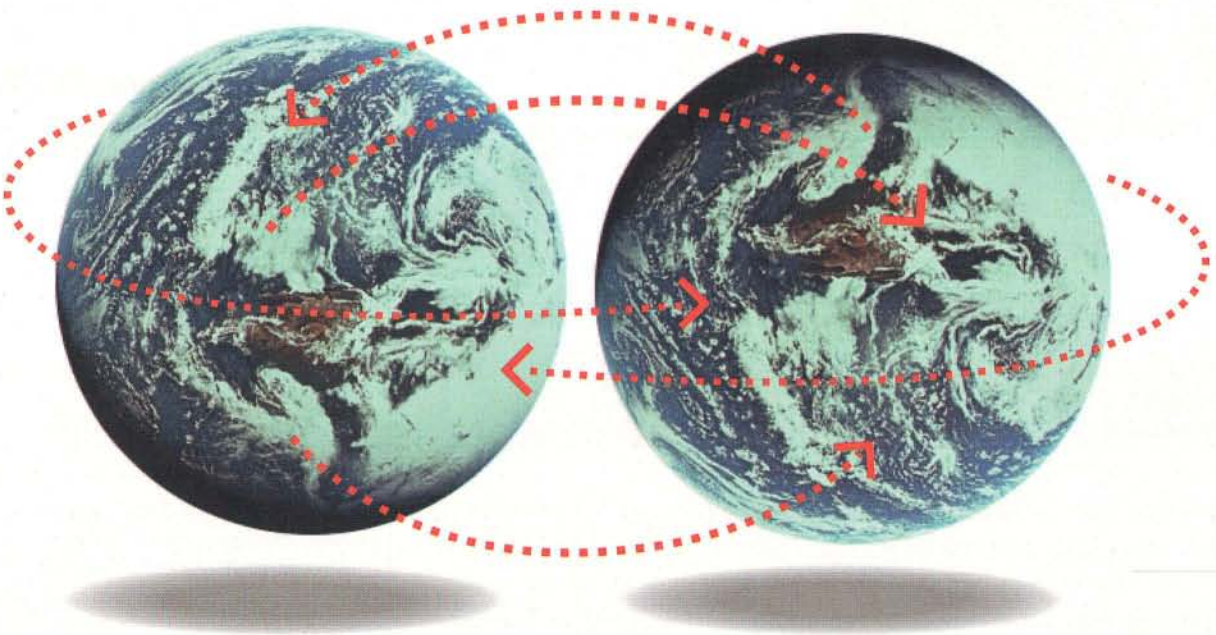

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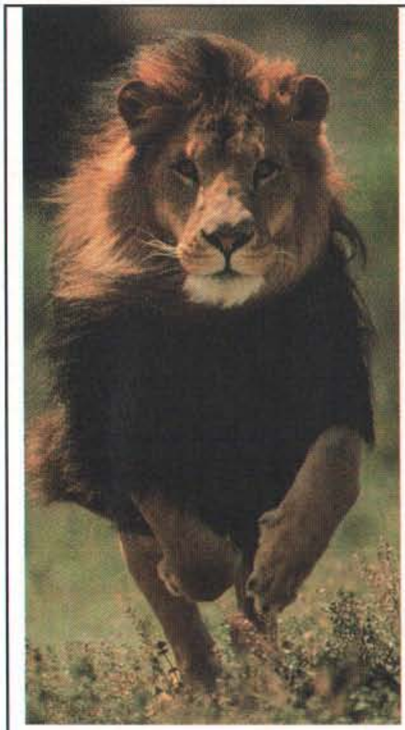

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nearly any SCSI device, including tape. SnapBack itself can be run from a hard drive or a floppy disk on any machine that will boot DOS. Once SnapBack is running, it doesn't care what OS it's installing on the target disk, nor does that target disk have to be formatted.

Novell system administrators will love the newest version of SnapBack, which lets you back up a hard drive and transfer everything to a new and larger drive with a larger Novell partition.

If you need this, you need it bad.

Our next upgrade was to replace the Pentium chip in Pentafluge. Intel makes it very easy to replace your math-defective Pentium chip. It took me longer than it will take you, because I happen to know a senior Intel vice president, and I called him. My friend handed the job to another executive, who passed it along to a third; eventually I got connected to the people who do this routinely, which is where I should have started. They asked a number of intelligent questions to establish the speed of my current Pentium chip and the kind of socket it sits in. Then they got my address and a credit-card number.

Intel really wants that old math-defective Pentium chip back, and if you don't send it in, they'll charge you about $500.

The credit-card number is required so that you'll have an incentive to return your old chip: Intel really wants that chip back, and if you don't send it in, they'll charge you about $500. However, they send self-addressed prepaid packaging, so returning your old chip is both simple and free.

The new chip comes with complete instructions. It took me less than 5 minutes to power down Pentafluge, open him up, replace his Pentium chip with the new one, connect the chip fan to the power supply, button up the machine, and restart it. It took another 5 minutes to box up the old chip and get it out.

I hoped my next hardware upgrade would be as easy as upgrading the Pentium, but it

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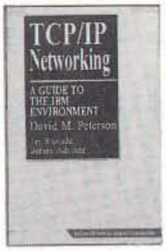

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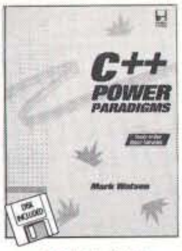

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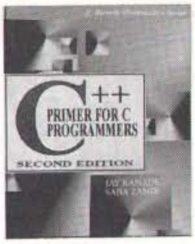

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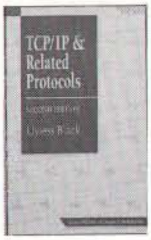

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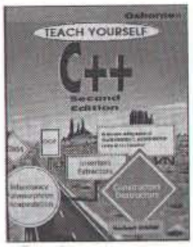

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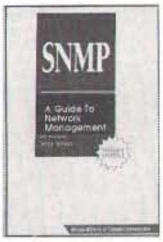

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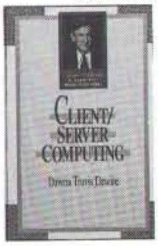

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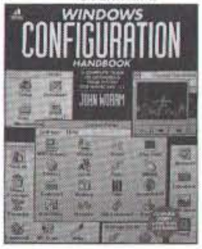

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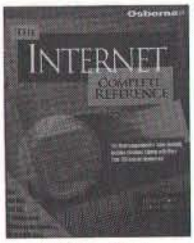

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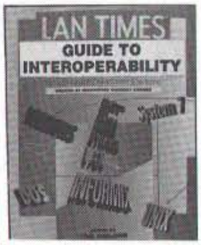

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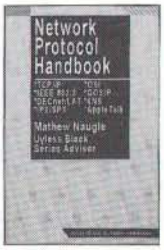

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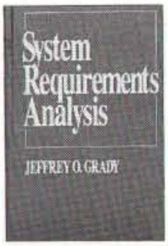

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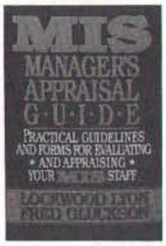
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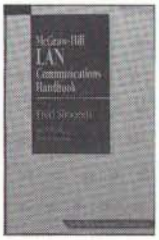

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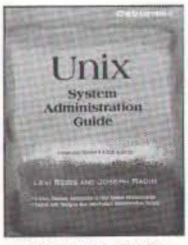

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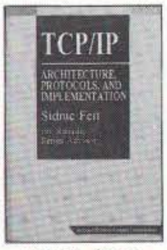

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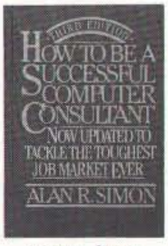
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didn't work out that way.

It started with a Western Digital Caviar AC31000 1.1-GB hard drive, which I used to upgrade SuperCow, the Gateway 2000 486DX2/66. I was in a hurry, so I figured that rather than transferring all the files from the 500-MB hard drive SuperCow came with, I'd install the Caviar as a second physical drive. Western Digital's instructions are clear and complete.

Alas, when I tried to partition the new drive, SuperCow could see only about 25 MB of the 1.1 GB. The instructions warned that might happen; the remedy is to get a new BIOS. That costs $80, and you get it from Micro Firmware (Norman, OK, (405) 573-5501; http://www.firmware.com). Ordering the BIOS took less than 5 minutes, including rebooting SuperCow to get the current BIOS version number.

SuperCow uses flash ROM, so the new BIOS came on a floppy disk. The documentation is excellent. About 10 minutes later, I had installed the BIOS and used FDISK to partition the Caviar AC31000. Formatting took another 10 minutes or so.

For most of you, that will be the end of the story, but apparently nothing is simple at Chaos Manor. My hard drive worked just fine, Windows for Workgroups came up, and I could share the new drive across the network—but for reasons we still don't understand, the Future Domain 8-bit SCSI card that runs Network Archivist and its DAT drive simply would not work.

I have two versions of that SCSI card, an ancient one that has no ROM and is thus ideal for using a DAT since it takes up no memory unless the tape is actually operating, and a later version with ROM that will run an 8-bit SCSI device string, including the Maximum Storage Duette read/write optical drive. Both worked fine before I upgraded the BIOS; neither works now. On boot-up, they report "Internal Self Check Failure."

I reported this to Micro Firmware and shortly after got E-mail from Robert Braver, president of the company. He made several suggestions, all sensible. None worked. Finally he asked me to send him the SCSI cards, which I did. Of course, they worked perfectly when he tried them on some of his Gateway 2000 486DX2/66 systems.

The next step will be to swap motherboards. Micro Firmware has offered to send me one; they're far more curious about what has caused this than I am.

The bottom line here is that the Western Digital Caviar AC31000 is easy to install and works splendidly. If you need to install a new BIOS—and you probably will if you have a machine more than a few years old—that won't be difficult. If you have problems, Micro Firmware has excellent technical support.

About a month ago, I got a strange offer, which I presume was made to a lot of journalists: Fujitsu would be pleased to send me one of its DynaMO 230 magneto-optical (MO) drives if I'd sign a pledge not to sell it for a year. Clearly, they're trying to break the lock SyQuest and Iomega established in much the same way.

This was no problem for me. I never sell anything I get for review. Some equipment goes back to the manufacturer, some gets destroyed, and quite a lot just gets used until it's obsolete, after which it goes to a local school; but I sure don't sell any of it. Anyway, I signed the agreement and specified the external model.

It's neat. The external drive is 5 by 8 by 1.5 inches thick, considerably smaller than the DAT unit. It comes with a little stand that will hold its slot vertical, but I laid it on its back. Unfortunately, I wasn't paying attention. I put it on the tower case of the Cheetah 386 and put the DAT unit on top of it. Over a week later, I discovered that I'd laid it upside down, completely covering the ventilation holes. I don't recommend that as standard practice, but it doesn't seem to have done any harm.

The DynaMO 230 came with an Adaptec 16-bit EZ-SCSI card. Installation was simple. Adaptec's documents are complete, and their installation software took care of it all. I had the DynaMO 230 running in 10 minutes. Then, just for luck, I put Network Archivist and the DAT drive on the same SCSI string. This is the drive that normally runs off the Future Domain card I'd sent to Micro Firmware for testing. When I booted up, the Adaptec card announced that it had found both the optical and tape drives, and when I brought up Network Archivist, that ran fine. Both the DAT drive and the DynaMO 230 are now sharable network resources.

The DynaMO 230 came with an order form for more optical disks: a five-pack of 230-MB MO disks costs $185. A 230-MB optical disk actually formats to 217 MB, so your medium cost is about 17 cents a megabyte. The optical disks are smaller (about the size of a 3½-inch floppy disk), and the drive is light and easy to carry around. The medium cost with DAT is about 1 cent a megabyte, but tape is a lot slower and less convenient.

The Fujitsu DynaMO 230 seems reliable. I've beat the living daylights out of it by setting up a batch file that writes and overwrites it for hours at a time. I did get a write-protect error when it was upside down, but standing it up to get some ventilation fixed the problem. It's fast. Though not as fast as the current generation of hard drives, it's faster than those we had five years ago. It takes a lot less time to write a backup copy to an optical drive than to a tape drive. Speed is important to backup systems: unless they're fast, you won't use them often. Every hour or so, I write a copy of my current work to a different machine; it would be as easy to write to an optical disk.

Everyone needs more disk space. If you are thinking of expanding, optical drives like Fujitsu's DynaMO 230 are well worth considering.

Continuing with upgrades, there's W95; I've had five builds in the last month. Each one cures another bug or two.

We went through builds 464, 480, 495, 501, and suddenly jumped to 950, which is probably a symbolic number. Build 950 installed easily—all the upgrades have—or so I thought until I tried to access the network.

There wasn't any network. Pentafluge couldn't see any other machines out there. I nearly panicked. Then I remembered I'd had a similar problem with OS/2 Warp Connect, so I tried the same remedy: I turned the machine off, counted to 10, and turned it back on.

That did it. When W95 came up, I looked into the Network Neighborhood folder, and voilà!, there were all my network resources.

There are still some problems. For example, while I use Microsoft Word for complex editing, I prefer to create text with a character-based editor. For years, I used the stand-alone version of Q&A Write, but my experience with Word has got me accustomed—*addicted* might be a better word—to using a mouse for moving and deleting blocks of text. Stand-alone Q&A Write doesn't have mouse support, but the Write built into Q&A 4.0 does, and I decided to write this column using that.

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BY1095

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Anyway, all went well until I needed to transfer an address from a previous column. What I usually do is open a DOS window running Microlytics' GOfer, send it out to search my old columns until it finds the company name, and use the Windows editing facility to mark and copy the text from the GOfer window and then paste it into the Q&A Write window. This works fine with stand-alone Q&A Write; but when I tried it with Write inside Q&A itself, I got an error message inviting me to recover with "escape." That "recovered" in the sense that I was back at the command level of Q&A, but all my text was gone.

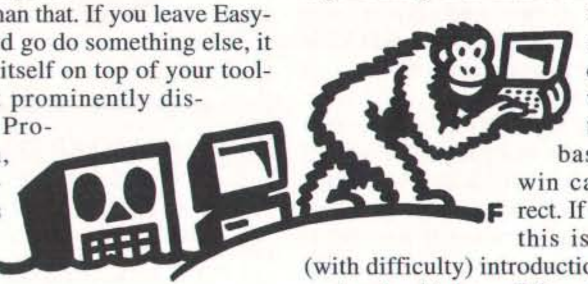
Fortunately, I save early and often, particularly before doing anything odd; I don't leave an editing window without saving my text first. Still, it's annoying, because text transfer through copy and paste is a convenient Windows feature. By mucking around, I find that I can paste into stand-alone Q&A Write, save the file, and read that saved file into Q&A. That's not a very convenient kludge.

I suppose I'll just have to bite the bullet and start using Word for text creation. On the other hand, finding bugs is fun....

W95 has multimedia support and a ton of features, so it's a natural for a multimedia tutorial program on CD-ROM. Alas, EasyTutor from CRT Multimedia isn't the right one for me. It has some slick multimedia, but while the introductory level is surely that, the detailed level doesn't go anywhere near far enough.

For instance, at the Microsoft W95 dog and pony show, they showed a lot of tricks using the registry and registry editor. W95 help on using the registry is skimpy to nonexistent, so I'd hoped this tutorial would tell me more. Alas, the Power User topic is no more useful on the subject than Microsoft's Help file.

It's worse than that. If you leave EasyTutor open and go do something else, it not only puts itself on top of your toolbar, where it prominently displaces the Programs item, but it somehow bollixes up the Alt-Tab task-switching feature. Closing EasyTutor fixes both problems.



I sure wish I had a good tutorial to explain the W95 registry, though.

I continue to work on Roberta's reading-instruction program. The Mac version has produced some astonishing results in beta tests. I'm upgrading the QuickBasic DOS version preparatory to putting it on Windows with Visual Basic.

In both cases, I'm using Crescent Tools from Progress Software. Visual Basic plus Crescent Tools gives you some truly awesome programming capabilities. The programs may not be as fast and compact as programs written in C++, but I really don't care. With Visual Basic, I can get things running in days, not months.

I'm also looking at 3D Choreographer from AniCom. It produces stand-alone animated sequences you can call with programs like PowerPoint—and, of course, Visual Basic. I've only just started with it, but it seems easy to use and solid.

The book of the month is *Independent Birth Of Organisms* by Periannan Senapathy (Genome International, 1994). Fair warning: this book is heavy reading, being nothing less than a new theory of evolution; or, rather, a critique of why current theories based on Darwin can't be correct. If nothing else, this is a readable (with difficulty) introduction to modern molecular biology. I found it fascinating, but then I like complicated scientific detective stories.

There are two computer books of the month from The Waite Group: *Visual Basic 4 How-to for Windows* and *QB Primer Plus*. These are excellent as both introductions and reference works.

There are about a zillion Internet books. One that's sort of fun is by Rawn Shah and James Romine, *Playing MUDs on the Internet* (Wiley, 1995). A MUD is a Multiuser Dungeon, and this will tell you what they are, how they work, and which ones to look into. That's worth knowing, because I suspect MUD technology will become important for business and education in the future.

The game of the month is Terror from the Deep, MicroProse Software's follow-on to XCOM: UFO Defense. The aliens are back, and they're really angry. Warning: as with many MicroProse games, this was released with bugs. Log on to GEnie or another on-line service and download the upgrade patch. Also available on GEnie is a great little "cryogenics" program that will let you transfer your XCOM troopers into this game.

One final note: they fly the DC/X with a mouse. When the Air Force turned the DC/X over to NASA after the flight, the presentation plaque sported a model of the ship and a Macintosh mouse. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on the Internet or BIX at jerryp@bix.com.

Product Information

The Caviar AC31000 (1 GB, $349) is easy to install and works splendidly. Contact Western Digital, Irvine, CA, (800) 832-4778 or (714) 932-5000; http://www.wdc.com.
Circle 1240 on Inquiry Card.

If you're thinking of expanding, optical drives like the **DynaMO 230 (external, $749; internal, $649)** are well worth considering. Contact Fujitsu Computer Products of America, San Jose, CA, (800) 626-4686 or (408) 432-6333.
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Installing and using **PartitionMagic (for OS/2 and DOS, $69; for DOS and Windows, $49)** is easy. Contact PowerQuest Corp., Orem, UT, (800) 379-2566 or (801) 226-8977; http://www.powerquest.com.
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Novell system administrators will love **SnapBack 3.06 (per server, $995),** which lets you back up a hard drive and transfer everything to a new and larger drive with a larger Novell partition. Contact Columbia Data Products, Altamonte Springs, FL, (407) 869-6700; http://www.cdpi.com.
Circle 1243.

System Commander ($99.95) lets you change OSes more easily than you used to be able to change CONFIG.SYS and AUTOEXEC.BAT. Contact V Communications, Inc., San Jose, CA, (800) 648-8266 or (408) 296-4224.
Circle 1244.

The game of the month is **Terror from the Deep (about $49.95).** Contact MicroProse Software, Hunt Valley, MD, (800) 879-7529 or (410) 771-1151; http://www.microprose.com.
Circle 1245.

3D Choreographer ($149) seems easy to use and solid. Contact AniCom, Inc., Chapel Hill, NC, (800) 949-4559 or (919) 967-2890; http://www.spadion.com/anicom.
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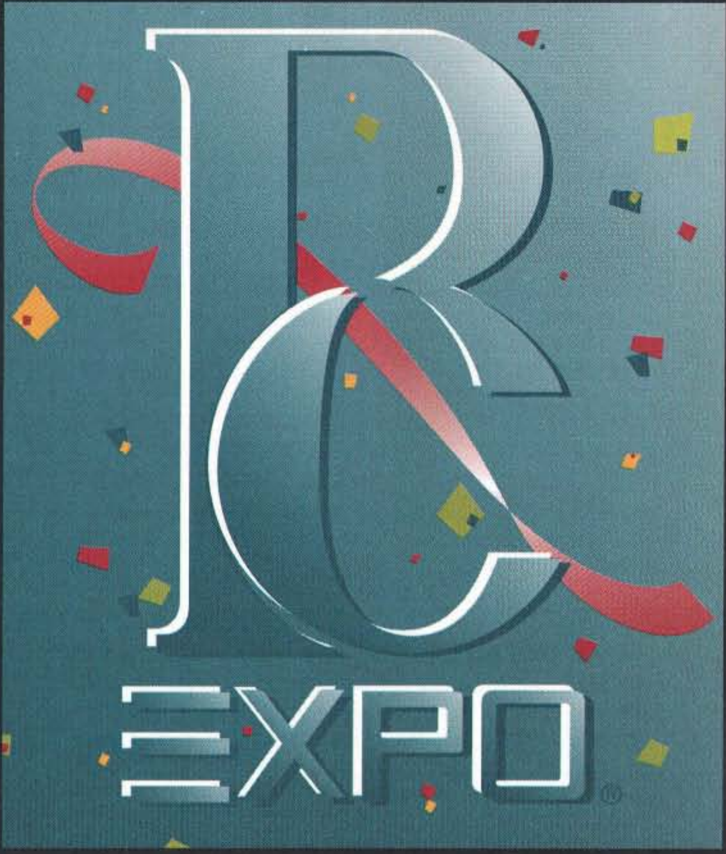

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WHAT'S NEW Hardware

PREVIEW **MAC POWERBOOKS**

Portable Mac: Power, Long Battery Life

With a 100- or 117-MHz PowerPC 603e at its heart, Apple Computer's latest line of PowerBooks combines RISC-processing power with insanely great battery life. Apple went with the 117-MHz specification for two reasons: 603e yields at 120 MHz were problematic, and Apple doesn't want to repeat the supply shortages that plagued the PowerBook 500 series.

BYTE looked at a preliminary PowerBook 5300c with a 100-MHz 603e and a 10.4-inch active-matrix color LCD screen. The PowerBook 5300c's long battery life is achieved through the power-saving features of the 603e, which saves its internal state while turned off, and the power management software in the Mac OS, which literally switches off the processor between keystrokes. A single lithium-ion battery provides an estimated 3 to 5 hours of battery life.

Battery-Life Performance

System	Hours
PowerBook 5300c (100-MHz PowerPC 603e)	6.87
PowerBook 540c (33-MHz 68LC040, two Type II NiMH batteries)	6.00
Toshiba 2150CDT (75-MHz 486DX4)	5.20
Toshiba T4900 CT (75-MHz Pentium)	4.25

We used BYTE's Thumper 2 on the PowerBook 5300c and obtained an impressive battery life of nearly 7 hours (see the table above). Although Thumper 2 imitates some keyboard activity, the 603e processor switches off between keystrokes, so BYTE's battery-life benchmark number is optimistic. But it does indicate that Apple's 3- to 5-hour estimate for heavy usage appears accurate. Your mileage will vary, depending on your work patterns and the PC Card (formerly PCMCIA) peripherals you use.

PowerBook 5300c
With a 100-MHz processor, 8 MB of RAM (expandable to 64 MB), a 500-MB hard drive, and a 9½-inch dual-scan gray-scale LCD screen, $2200; with a 10.4-inch active-matrix color LCD screen, $3800.

Apple Computer
Cupertino, CA
(800) 776-2333
(408) 996-1010

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Other notable features include a 32-bit I/O bus; a PC Card slot, which holds one Type III or two Type II cards; an infrared communications port; and a storage bay that holds a removable floppy drive or other storage media.

In sum, the PowerBook 5300c racks up Pentium-caliber performance and impressive battery life far beyond what we've seen with 486- or Pentium-equipped notebooks, all in a package weighing in at 6.2 pounds.

—**Tom Thompson**

133-MHZ SUPERSYSTEM

Specifically designed for CAD and engineering applications, the Tri-CAD 133/SS is built around Intel's 133-MHz Pentium processor and a PCI-bus motherboard. The 133/SS ($7399) comes with 32 MB of EDO RAM; a 1.6-GB hard drive; 256 KB of TriStar's proprietary CADcache; a dual-channel 32-bit EIDE controller; an Elsa Winner 2000 Pro/X graphics accelerator with 8 MB of video memory, 1600-by 1200-pixel resolution, and an 85-Hz refresh rate; a 21-inch ViewSonic digital monitor; a hex-speed CD-ROM drive; and a 28.8-Kbps internal fax modem.

Contact: Tri-Star Computer, Tempe, AZ, (800) 800-7668 or (602) 731-4926.

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Contact: Gandalf Technologies, Nepean, Ontario, Canada, (800) 426-3253 or (613) 723-6500; http://www.gandalf.ca.

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MULTIFUNCTION WORKCENTER ▲

The Document WorkCenter Pro 610 ($2495) delivers plain-paper laser-faxing and digital-copying features together with optional printing and scanning. You can program up to 100 auto-dial numbers and up to 10 one-touch group dials for fax broadcasting. Up to 10 individual mailboxes let you receive and retrieve faxes from remote locations. The 40-page memory is upgradable to 200 pages ($199), and the 250-sheet paper tray is upgradable to 500 sheets ($99). The optional Windows and DOS printing capability ($495) supports PCL 5e with 600-dpi resolution. The scanning option ($99) offers a resolution of 300 by 300 dpi, which you can use with TWAIN-compatible software packages, and OCR capability via TextBridge 3.0.

Contact: Xerox, Palo Alto, CA, (800) 275-9376 or (415) 813-6800; http://www.xerox.com.

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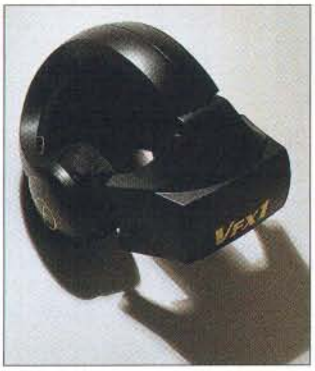

VIRTUAL-REALITY HEADGEAR ▲

An integrated headset, the VFX1 Headgear Virtual Reality System ($995) features high-contrast 789- by 230-pixel LCDs, a three-axis VOS Head Tracker, high-fidelity stereo headphones, a ComSet microphone, a Smart Visor, and custom lenses. The system includes the CyberPuck controller, a device that provides additional virtual-reality input, and a CD-ROM with playable versions of PC-based games such as Electronic Arts' Magic Carpet and Interplay's Descent. The VFX1 Headgear Virtual Reality System also incorporates Access.bus technology, which lets you simultaneously connect up to 125 devices to your PC.

Contact: Forte Technologies, Rochester, NY, (716) 427-8595; sales@fortech.com.

Circle 981 on Inquiry Card.

INTERNAL OR EXTERNAL TAPE BACKUP DRIVES

The Ditto 420 (internal, $99.95; external, $199.95) can back up 420 MB of information on a single QIC-wide tape. Using Travan technology, which enables you to back up and restore more than 3 GB of information in a single, unattended session, the Ditto 800 (internal, $199.95; external, $299.95) has the ability to back up 800 MB of data, and the Ditto 3200 (internal, $299.95; external, $399.95), 3.2 GB of data. The Ditto 800 and Ditto 3200 drives are all compatible with QIC, QIC-wide, Travan, and Irwin tape formats.

Contact: Iomega, Roy, UT, (800) 697-8833 or (801) 778-1000; http://www.iomega.com.

Circle 979 on Inquiry Card.

MULTIMEDIA X TERMINALS

The TekXpress XP400 series X terminals ($2695 to $4795) are designed to provide a single desktop solution for graphical access to network information and distributed multimedia applications. The systems all come with an LSI 33120 RISC processor; 8 MB of RAM, expandable to 136 MB; 2 MB of video memory; a twisted-pair Ethernet interface; two RS-232 ports; and a monitor. Options include an MPEG digital-video coprocessor, an audio coprocessor, thinnet and thicknet interfaces, flash memory, a dual-slot PC Card (formerly PCMCIA) interface, a parallel port, a keyboard, and a Sony 20-inch monitor. With the Tek XpressWare software, the XP400 series systems can access network-mainframe, legacy, and Unix applications. With the WinDD software, you can display Windows and other PC applications on your XP400.

Contact: Tektronix, Wilsonville, OR, (800) 547-8949 or (503) 682-7300; http://www.tek.com.

Circle 983 on Inquiry Card.

COLOR-THERMAL PRINTERS

The latest models in the Spectra*Star line of plain-paper color-thermal printers are the Model 240 ($2995) and the top-of-the-line Model 280 ($3995). Both models support PostScript Level 2 and Pantone-certified color matching and offer serial, parallel, and AppleTalk ports. A Color Copy Cartridge (about $200) plugs into the Pockette slot and provides a connection to popular color scanners, so you can also use the printers as full-color copiers.

The Spectra*Star Model 240 uses a 25-MHz Intel 80960CA RISC processor and comes with 6 MB of RAM (expandable to 24 MB) and 52 professional fonts. It can print at resolutions of up to 600 by 300 dpi with additional RAM. The Spectra*Star Model 280 uses the Intel 33-MHz 80960CF RISC processor and comes with 10 MB of RAM (which is expandable to 32 MB), 52 professional fonts, and two Pockette slots, which can accommodate a plug-in Ethernet LAN cartridge and a 120-MB hard drive cartridge.

Contact: General Parametrics, Berkeley, CA, (800) 223-0999 or (510) 524-3950.

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CABLE MANAGEMENT TOOL

The PentaScanner+ with 2-Way Injector+ ($4595), PentaScanner Cable Admin with Super Injector ($2795), and PentaScanner+ with Super Injector ($3495) all offer hand-held cable certification and diagnostics; 100-MHz operation; support for UPT, STP, ScTP, and coaxial cable; measurement of NEXT, attenuation, length, impedance, resistance, capacitance, attenuation to cross-talk ratio, wire map, and noise; support for network topologies, such as 10- and 100-Mbps Ethernet, Token Ring, and ATM; replaceable, rechargeable nicad batteries; printing of test results; a backlit display; and flash memory. The 2-Way Injector+ accessory measures near-end cross talk and attenuation on both ends of the installed network cable link.

Contact: Microtest, Phoenix, AZ, (602) 952-6400; 70414,2116@compuserve.com.

Circle 991 on Inquiry Card.

DO-IT-YOURSELF CD-ROM RECORDING

At the heart of the Spressa 920 is an internal CD-R drive with a maximum sustained data transfer rate of 300 KBps, a 1-MB data buffer, and the ability to record a 650-MB disc in about 30 minutes. If a buffer underrun occurs, the drive's disk-recovery algorithm seals off the section of the disc where the error occurred, allowing the Spressa 920 ($1999.95) to use the rest of the disc. The drive can record in many CD formats, including CD-ROM, CD-ROM XA, CD-Audio, Audio-Combined CD-ROM, CD-I, Photo CD, and Video CD, and offers three recording methods: disc at once, incremental, and multisession.

Contact: Sony Component and Computer Products Group, San Jose, CA, (800) 352-7669 or (408) 432-1600.

Circle 977 on Inquiry Card.

WHAT'S NEW Hardware

SCALABLE NETWORK SERVERS

The NetServer LS Series of network servers (about $6506 to $18,611) are scalable from single-processor Intel Pentium/75 systems to quad-symmetric-multiprocessor Pentium/100 and Pentium/133 systems. Features include a 64-bit clock-independent system bus; dual PCI peer buses; dual PCI fast-and-wide SCSI-2 controllers in RAID levels 0, 1, 5, and 6; dedicated Level 2 caches; error-checking-and-correcting memory that's expandable to 768 MB; and MPS support. A hot-swap disk subsystem lets you replace failed drives while the server continues to work and automatically reconstructs data on a spare drive. An Automatic Server Restart feature reactivates the server if the network OS hangs.

Contact: Hewlett-Packard, Santa Clara, CA, (800) 322-4772 or call local HP dealer; http://www.hp.com/go/netserver.

Circle 978 on Inquiry Card.

PCI-BASED MULTIMEDIA ACCELERATOR FOR POWER MAC

The Diamond Javelin Video 3000 series includes the Javelin Video 3240XL ($399), which provides 2 MB of video memory (upgradable to 4 MB) and supports 16.7 million colors at resolutions of up to 1152 by 870 pixels, and the Javelin Video 3400XL ($569), which contains 4 MB of video memory. Both models feature a 220-MHz DAC, which provides flicker-free refresh rates of up to 120 Hz, and the S3 Vision968, which provides digital-video scaling of up to 1280 by 1024 pixels.

Contact: Diamond Multimedia Systems, San Jose, CA, (800) 468-5846 or (408) 325-7000; http://www.diamondmm.com.

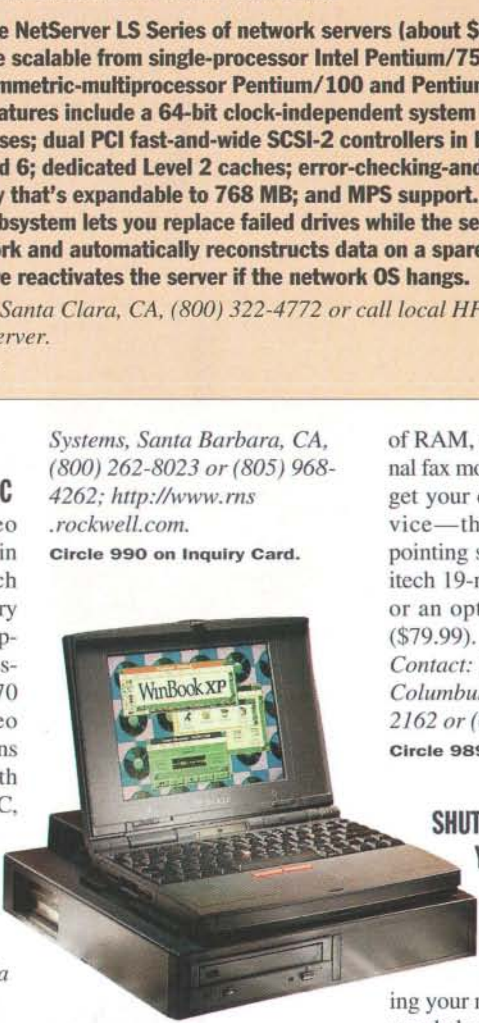
Circle 988 on Inquiry Card.

FAST ETHERNET ADAPTER

The Rockwell 2300-TX provides 10- or 100-Mbps automatic negotiation and connectivity to PCI-based desktop PCs and servers, as well as half- and full-duplex operation. You can port the VDA common-core software architecture across a range of network interface cards, OSes, and network-protocol environments. The Rockwell 2300-TX ($295) is fully compliant with the emerging IEEE 802.3u 100Base-TX Ethernet standard.

Contact: Rockwell Network Systems, Santa Barbara, CA, (800) 262-8023 or (805) 968-4262; http://www.rns.rockwell.com.

Circle 990 on Inquiry Card.



QUAD-SPEED CD-ROM DOCKING STATION AND MORE▲

WinBook Computer's docking station ($399) comes with a quad-speed CD-ROM drive, two ISA slots, dual 5¼-inch bays, automatic detection for external pointing devices, VGA, stereo output, and volume control.

In addition, the 100-MHz 486DX4 model of the WinBook XP notebook computer comes in two configurations: with a 10.3-inch dual-scan color screen, 4 MB of RAM (expandable to 32 MB), and a 340-MB removable hard drive ($1999); or with an 810-MB removable hard drive, an active-matrix screen, 16 MB of RAM, and a 14.4-Kbps internal fax modem ($4199). You also get your choice of pointing device—the standard Lexmark pointing stick, an optional Logitech 19-mm trackball ($29.95), or an optional Alps touchpad ($79.99).

Contact: WinBook Computer, Columbus, OH, (800) 468-2162 or (614) 481-8041.

Circle 989 on Inquiry Card.

SHUTTLE BIG FILES AMONG YOUR MACS

If you need to transport large data, graphics, or digital-video files without burdening your network, the DataDock may help. Two configurations are available: a $799 desktop unit, which accommodates two modules, and a rack-mount unit (from $885), which accommodates up to six modules. The hard drive modules ($870 to $2499) are available in fast SCSI-2 configurations with capacities of up to 4 GB each. Options include fast-and-wide SCSI-2 hard drives in the same capacities (from $3420); DAT drives of up to 8 GB ($1695 each); 270-MB Syquest modules ($790 each); and 230-MB magneto-optical drives ($1050 each).

Contact: MicroNet Technology, Irvine, CA, (714) 453-6100; micronet@aol.com.

Circle 984 on Inquiry Card.

DESKTOP-RECORDABLE CD-ROM SOLUTION

With CD-Write Now, you can record your own CD-ROM discs, storing 650 MB of data on each disc. Multisession support lets you write to the disc incrementally, performing up to 99 writing sessions on each CD-ROM. An optional recording-simulation mode enables you to test applications by simulating CD performance without actually writing to a disc. The basic package ($2495) includes a double-speed drive (a quad-speed drive is also available), authoring software for Windows or the Macintosh, and two discs.

Contact: Ten X Technology, Austin, TX, (800) 922-9050 or (512) 918-9182; tenx@zilker.net.

Circle 987 on Inquiry Card.

STORAGE SERVERS FOR NOVELL LANS ▼

The GlobalNet family of storage servers give up to 1024 users access to SCSI mass-storage devices over an Ethernet network. Each unit has built-in software and configures itself, registering on NetWare's server list as another attachable Novell server. The servers, which provide data transfer rates of up to 450 KBps, include GlobalNet SST ($7995), designed for large-capacity optical jukeboxes, GlobalNet Shuttle ($5995), for midrange optical jukeboxes, and GlobalNet Route 101 ($3995), for large hard drives and RAID drives.

Contact: Optisys, Glendale, AZ, (800) 327-1271 or (602) 997-9699; rzwick@optisys.com.

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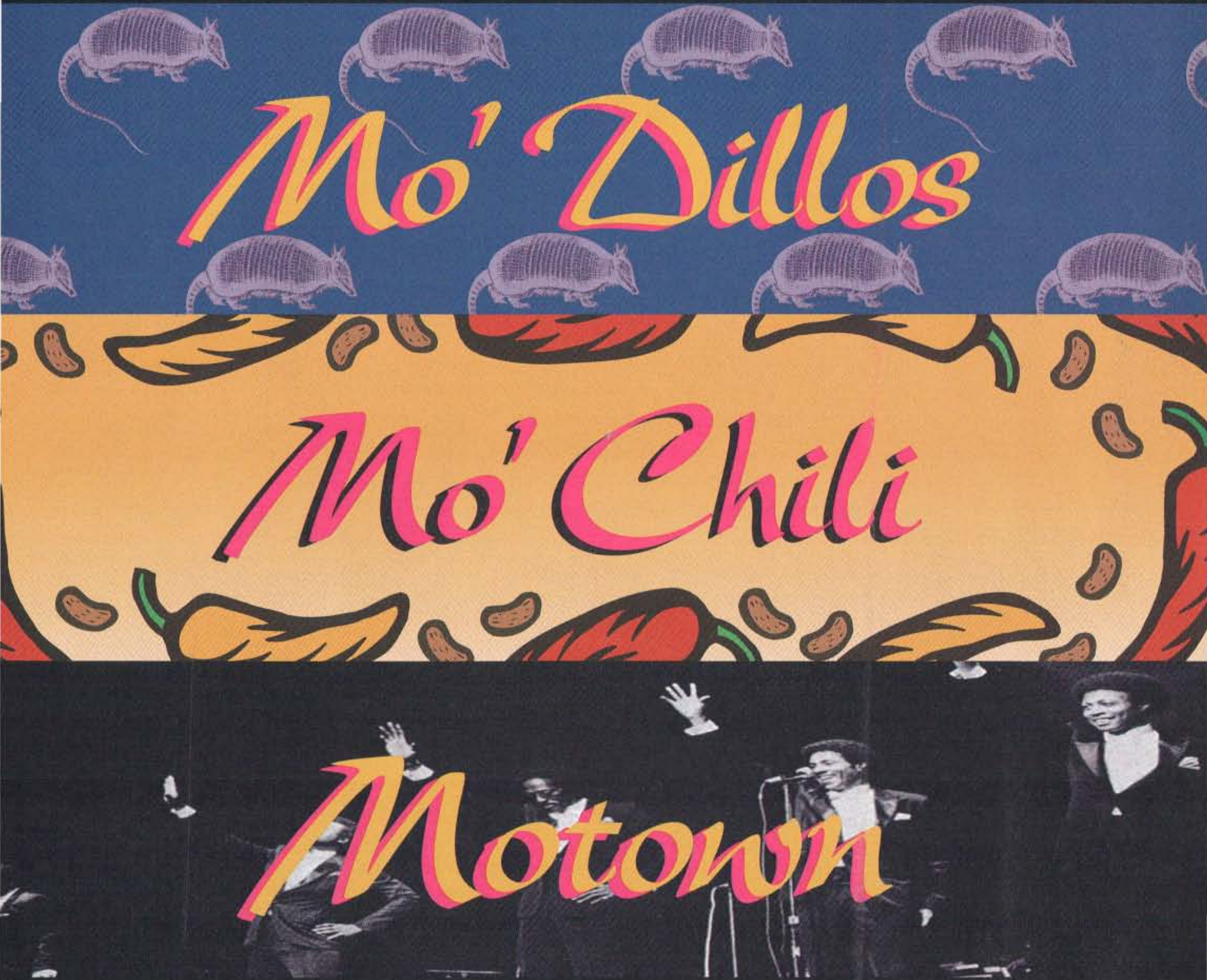

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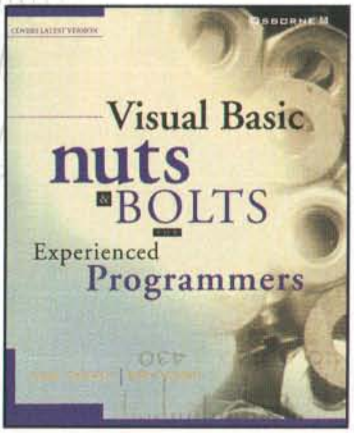

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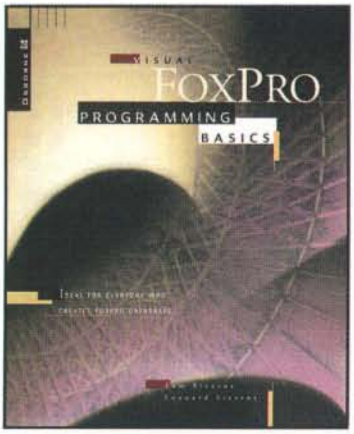

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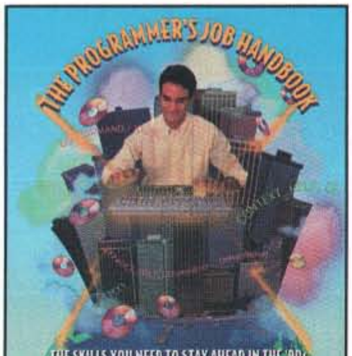
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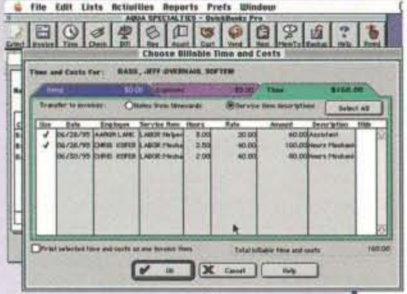
WHAT'S NEW Software

PREVIEW **SMALL-BUSINESS ACCOUNTING**

Juggle Many Projects with QuickBooks Pro

QuickBooks Pro, the enhanced version of Intuit's small-business accounting program, integrates time-tracking, estimating, and job-costing features that are not normally found in inexpensive packages. The program is available in versions for Windows 3.1 and the Mac ($189 each); BYTE looked at a prerelease version of QuickBooks Pro for the Mac.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Choose Billable Time and Costs
Select All
OK
Cancel
Help

One intriguing feature is QuickBooks Pro's ability to maintain running time sheets for each employee, tallying the number of hours spent on a particular client's projects. Formerly, you had to track this information using a specialized application or spreadsheet or, worse, scrap paper. But with just a few mouse-clicks in QuickBooks Pro, you can transfer billable hours to invoices for individual jobs or clients. You can also create reports that evaluate the profitability of an employee, client, or specific project. The time sheets are simple to maintain and could be an invaluable tool for businesses that juggle several projects at once. In addition, time-sheet information readily flows to the payroll module for computing pay for wage-based employees.

QuickBooks Pro also lets you produce estimates, a small-business chore that's typically performed on a spreadsheet. You can easily convert estimates to invoices and modify the invoices without changing the original estimates. The program also lets you generate reports that compare estimates with actual sales.

Like Quicken, QuickBooks Pro is designed for people who have minimal accounting skills but need to rapidly and economically manage their business finances. The program is powerful and multifaceted, but it's accessible to the novice. With QuickBooks Pro, you can focus your business on the talents that generate income rather than getting bogged down in managing a paper trail of invoices, estimates, and cost-accounting. **—Chris Kofer**

Intuit
Menlo Park, CA
(800) 624-8742
(415) 322-0573
Circle 994 on Inquiry Card.

ON-LINE COMMUNICATIONS FOR WINDOWS 95

Among the features of Qmodem-Pro for Windows 95 version 2.0 ($129) are TAPI support, which allows the sharing of communications devices among multiple applications; MAPI support, which lets you transfer text, images, and files to major E-mail programs; OLE 2.0 support, which lets you drag a phonebook entry directly to the Windows 95 desktop and connect to that service right from the desktop by clicking on the icon; support for long filenames; and path support. A script language with QuickLearn capabilities lets you automate on-line sessions and create custom interfaces; it also contains a compiler, a debugger, and a syntax-highlighting editor.

Contact: Mustang Software, Bakersfield, CA, (800) 999-9619 or (805) 873-2500; http://www.mustang.com.

Circle 997 on Inquiry Card.

MUNICIPAL ENGINEERING OFFICE

A CAD solution for the modeling, analysis, and design of water-distribution networks and wastewater-collection systems, Municipal Engineering Office ($5000) for Windows NT includes the InWater, InSewer, and Relational Information System components. InWater enables you to graphically model and analyze water-distribution systems with data transfer to and from analysis engines, such as KYPipe. A modeling solution for analyzing and designing wastewater collection, transport, and disposal systems, InSewer combines automated design and engineering tasks with relational-database capabilities. Relational Information System is a generic interface for communicating information across a networked environment. The package also includes DraftWorks, an automated drawing-production application.

Contact: Intergraph, Huntsville, AL, (800) 345-4856 or (205) 730-5499; http://www.intergraph.com.

Circle 1005 on Inquiry Card.

DISTRIBUTED SOFTWARE MANAGEMENT

A software management solution designed for PC LANs, NetWizard 2.5 (10-user pack, $595) provides automated software and hardware inventory, software distribution, software metering and licensing, and remote configuration. NetWizard lets you install software on hundreds of desktops from a single location; generate scripts automatically using the Package Editor; use visual script editors to develop complex scripts without any programming; compress distribution packages for efficient transmission; and eliminate redundant software installation/update overhead.

Contact: Attachmate, Bellevue, WA, (800) 426-6283 or (206) 644-4010; http://www.attachmate.com.

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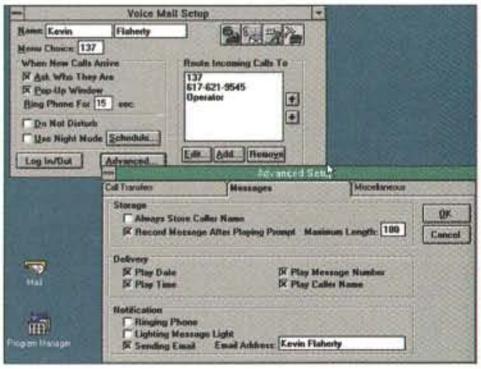
32-BIT OLE CONTROLS FOR WINDOWS TELEPHONY ▼

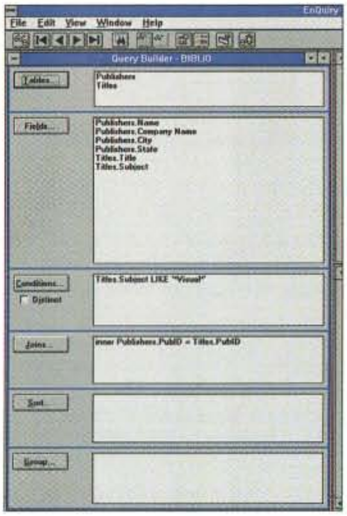
Using Visual Voice for Win32 (for Windows NT, from $795; for Windows 95, from $495), you can create applications—including fax-on-demand, interactive voice response, and voice mail—that can interact with most data sources and networks. The program provides high-level interfaces to functions such as answering inbound calls, placing outbound calls, prompting for Touch-Tone input once calls are established, recording and playing back voice files, sending and receiving faxes, and integrating with a PBX to perform call-control functions. The Voice Workbench tool visually defines the telephony components of an application and generates the corresponding application logic. A 32-bit DLL interface allows 32-bit development environments that support DLLs to take advantage of Visual Basic's telephony features.



Name: Kevin Flaherty
Menu Choice: 137
When New Calls Arrive
☒ Ask Who They Are
☒ Pop-Up Window
Ring Phone For: 15 sec
☐ Do Not Disturb
☐ Use Night Mode
Route Incoming Calls To
137
617-621-9545
Operator
Storage
☐ Always Store Caller Name
☒ Record Message After Playing Prompt Maximum Length: 180
Delivery
☒ Play Date
☒ Play Time
☒ Play Message Number
☒ Play Caller Name
Notification
☐ Ringing Phone
☐ Lighting Message Light
☒ Sending Email Email Address: Kevin Flaherty

Contact: Stylus Innovation, Cambridge, MA, (617) 621-9545; http://www.stylus.com.

Circle 1009 on Inquiry Card.



Publishers
Titles

Publishers.Name
Publishers.Company Name
Publishers.City
Publishers.State
Titles.Title
Titles.Subject

Titles.Subject LIKE "Visual"

inner Publishers.PubID = Titles.PubID

CLIENT/SERVER CAPABILITIES FOR VISUAL BASIC ▲

EnQuiry ($395) lets Visual Basic programmers rapidly and visually build forms and queries without coding. With the Query Builder, you can graphically manage and control virtually all aspects of the SQL query-and-control layout process. The Query Advisor reveals the status of the query-building process as it proceeds, flagging errors and providing advice and guidance for correcting problems. The EnQuiry Form Preview displays the results of your queries and the way data is presented to users.

Contact: Progress Software, Crescent Division, Bedford, MA, (800) 352-2742 or (617) 280-4000; crescent@progress.com.

Circle 1002 on Inquiry Card.

CASH-FLOW FORECASTS FOR EXCEL 5

PFP Maxima II for Excel 5 for Windows (US$199) formats your company's financial statements and calculates federal, state, and local taxes; interest; management bonuses; long-term loans; cash flows; bank-credit-line working limits; ratio analysis; and break-evens. You can add, delete, or change accounts where appropriate, and the program's report capabilities include up to 17 presentation-quality financial statements and supporting schedules (monthly and annually).

Contact: Pendock Mallorn, Toronto, Ontario, Canada, (416) 264-2126.

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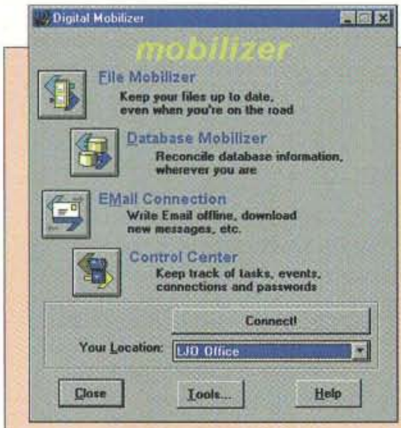
INTERNET INTEGRATION AND WORKGROUP COLLABORATION

Ecco Pro 3.0 ($175) adds more than 100 features, including an Internet Address Book; AutoAssign, an organizer that categorizes information into specific Ecco folders based on user-definable rules; and a correspondence manager, which lets you automatically send faxes, E-mail, and letters to any number of contacts simultaneously. Enhancements include Notepads for outlining the details of your projects, a Rolodex card interface, tabs to switch between views, revised menus and dialog boxes, icon balloon help, and a print coach for print layouts. The Internet Address Book comes preconfigured with over 2000 gopher, World Wide Web, and FTP sites. While surfing the information highway, you can use the Shooter to send selected information from the Internet to Ecco Pro 3.0, where the information and its Internet address are stored. The Time and Expenses feature lets individuals and workgroups track expenses for activities such as projects and calls.

Contact: NetManage, Cupertino, CA, (408) 973-7171; http://www.netmanage.com.

Circle 1000 on Inquiry Card.



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Keep track of tasks, events, connections and passwords

Your Location: LJD Office

SOFTWARE FOR MOBILE WORKERS

Mobilizer for Windows (single-user package, $299) integrates office-mail, file, and database applications and mobilizes them for use on a remote laptop, giving mobile workers the flexibility to communicate over traditional wired phone lines or wireless telecommunications services. The product consists of four components. File Mobilizer allows transparent access to LAN network drives and lets you specify the files you want to mobilize. ConnectSoft's E-Mail Connection software lets you download, review, and respond to mail off-line through one integrated user interface. With Database Mobilizer, you can cache and query corporate databases in a store-and-forward manner using ODBC drivers. The Mobile Communications Manager automates connections over both wired and wireless communications services.

Contact: Digital Equipment, Littleton, MA, (800) 344-4825 or (508) 486-2254; http://www.digital.com/info/mobile.

Circle 995 on Inquiry Card.

Software Update

Conversions Plus 3.0 for Windows, the PC-to-Mac file-exchange utility, adds translators for TIFF, JPEG, GIF, BMP, PCX, and EPS graphics; Quattro Pro 5.0 and 6.0 and Lotus WK4 4.0 and 5.0 spreadsheets; WordPerfect 6.1; Microsoft Works 4.0 Macintosh; ClarisWorks 2.x, 3.x, Mac, and PC; and WordPerfect Works 2.0 Windows. The package also offers enhanced graphics capabilities and a file-preview feature. $149.

Contact: DataViz, Trumbull, CT, (800) 733-0030 or (203) 268-0030.

Circle 1011 on Inquiry Card.

A data-query, reporting, and analysis tool, **Forest & Trees 4.0** offers an expanded query capability, including the ability to conduct ad hoc queries without having knowledge of SQL or the target-database structure; data-analysis features, such as alarms, graphs, cross-tabs, and single-click data interpretation; and customization facilities. Administrative version, $995; Enterprise version, $790.

Contact: Trinzic, Redwood City, CA, (800) 952-8779 or (415) 591-8200.

Circle 1012 on Inquiry Card.

WinDelete 2.0 for Windows monitors application installation to enable better application removal, covers most types of applications and system-support files, previews its changes before making them, offers a one-step undo/restore feature, and has tools to facilitate better system management, such as intelligent uninstalling of more file types, effective management of system files, and personalized system tips and information. $49.95.

Contact: IMSI, San Rafael, CA, (800) 833-8082 or (415) 257-3000; http://www.imsisoft.com.

Circle 1013 on Inquiry Card.

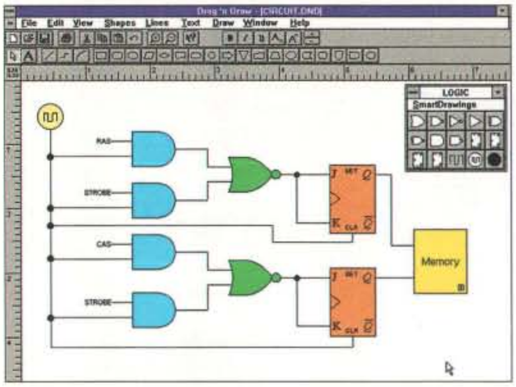
WHAT'S NEW Software

CREATE DESIGNS AND DIAGRAMS ▼

Designed to meet your drawing and diagraming needs, Drag 'n Draw for Windows ($149) provides SmartDrawing Libraries that are aimed at the scientific, technical, and business communities; tools to simplify the drawing process from start to finish; and a system for customizing objects and drawings and linking them to other objects. Drag 'n Draw enables you to create such diagrams as electrical schematics, fish-bone charts, flowcharts, landscapes, network diagrams, organizational charts, time lines, quality-control diagrams, and space-planning and technical drawings.

Contact: DeltaPoint, Monterey, CA, (800) 446-6955 or (408) 648-4000; http://www.deltapoint.com.

Circle 1007 on Inquiry Card.


Drag 'n Draw - [CIRCUIT.DND]
File Edit View Shapes Lines Text Draw Window Help
LOGIC
SmartDrawings
RAS
STROBE
CAS
STROBE
Memory

PC DIAGNOSTICS

With PC Certify Pro, you can conduct thorough diagnostic testing of IBM PC and compatible systems. The program features 10 test-group profiles, 18 command-line switches, and unlimited reporting. In addition to quick diagnostics, the system-load test can perform a 24-hour system burn-in in just 2.4 hours. The test roster includes all the major system components, including CPU, FPU, memory, motherboard, video adapter, serial and parallel ports, hard disks, disk drives, system load, keyboard, internal speaker, mouse, joystick, printer, SCSI, CD-ROM, and other devices, such as sound card, fax, and stacker. PC Certify Pro ($249) also comes with 11 diagnostics utilities to help you pinpoint system errors.

Contact: Landmark Research International, Clearwater, FL, (800) 683-6696 or (813) 443-1331; 71333.2735@compuserve.com.

Circle 1008 on Inquiry Card.

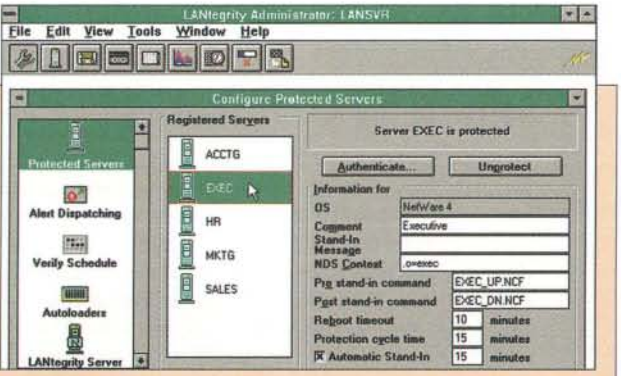
FREEHAND 5 FOR WINDOWS

A native 32-bit application for graphic design and illustration, FreeHand 5 for Windows ($595) comes with more than 500 fonts and 10,000 clip-art images and provides cross-platform graphic illustration. New features include an expandable architecture, style sheets, a spelling checker, search and replace, strike-through, highlighting, optional text-edit windows, an optional text ruler, and special effects. FreeHand 5 also supports text-handling capabilities, which let you lay out multipage brochures and advertisements, and floating palettes. Import/export capabilities let FreeHand open and place CorelDraw 3 and 5 files, as well as files from Illustrator.

Contact: Macromedia, San Francisco, CA, (800) 288-4797 or (415) 252-2000; http://www.macromedia.com.

Circle 1001 on Inquiry Card.

SERVER-FAULT RESILIENCE



Server EXEC is protected

Information for

OS: NetWare 4

Comment: Executive

Stand-In Message:

NDS Context: .o=exec

Pre stand-in command: EXEC_UP.NCF

Post stand-in command: EXEC_DN.NCF

Reboot timeout: 10 minutes

Protection cycle time: 15 minutes

☒ Automatic Stand-In: 15 minutes

Initially available for NetWare, LANtegrity (license for 100 users, $4950; for 1000 users, $11,500) is a hot standby solution that provides instant recovery for failed servers. The program continuously monitors all protected servers and can automatically stand in for any server within 15 seconds of detecting a failure. Users simply log in and access the same user accounts, files, and client software as if they were connected to their usual server. An Intelligent Data Vault feature maintains archival copies of all current and previous versions of files and manages the most active files in disk storage and all the current files in tape auto-loader storage. LANtegrity also lets you upgrade or reconfigure servers without disturbing users' access to their files.

Contact: Network Integrity, Marlborough, MA, (508) 460-6670.

Circle 996 on Inquiry Card.

Software Update

The Windows version of the relational database, **4th Dimension 3.5** provides built-in multitasking, a 4GL with more than 350 commands for customizing applications and adding extensions to databases, a graphical interface that supports Windows and the Mac, and an optional compiler that compiles code into machine language. $895.

Contact: ACI US, Cupertino, CA, (408) 252-4444.

Circle 1014 on Inquiry Card.

The Secure Workplace for OS/2 3.0, a product that provides workstation security, extended control of the Workplace Shell, and workplace management utilities, includes increased compatibility with OS/2 Warp; the ability to secure every object on the Workplace Shell, including disk and file objects; new audit-trail and user-authentication facilities; a new desktop-switching utility; and improved desktop management utilities. Standard edition, $59.95; Enterprise edition with 10-station-license minimum, $549.

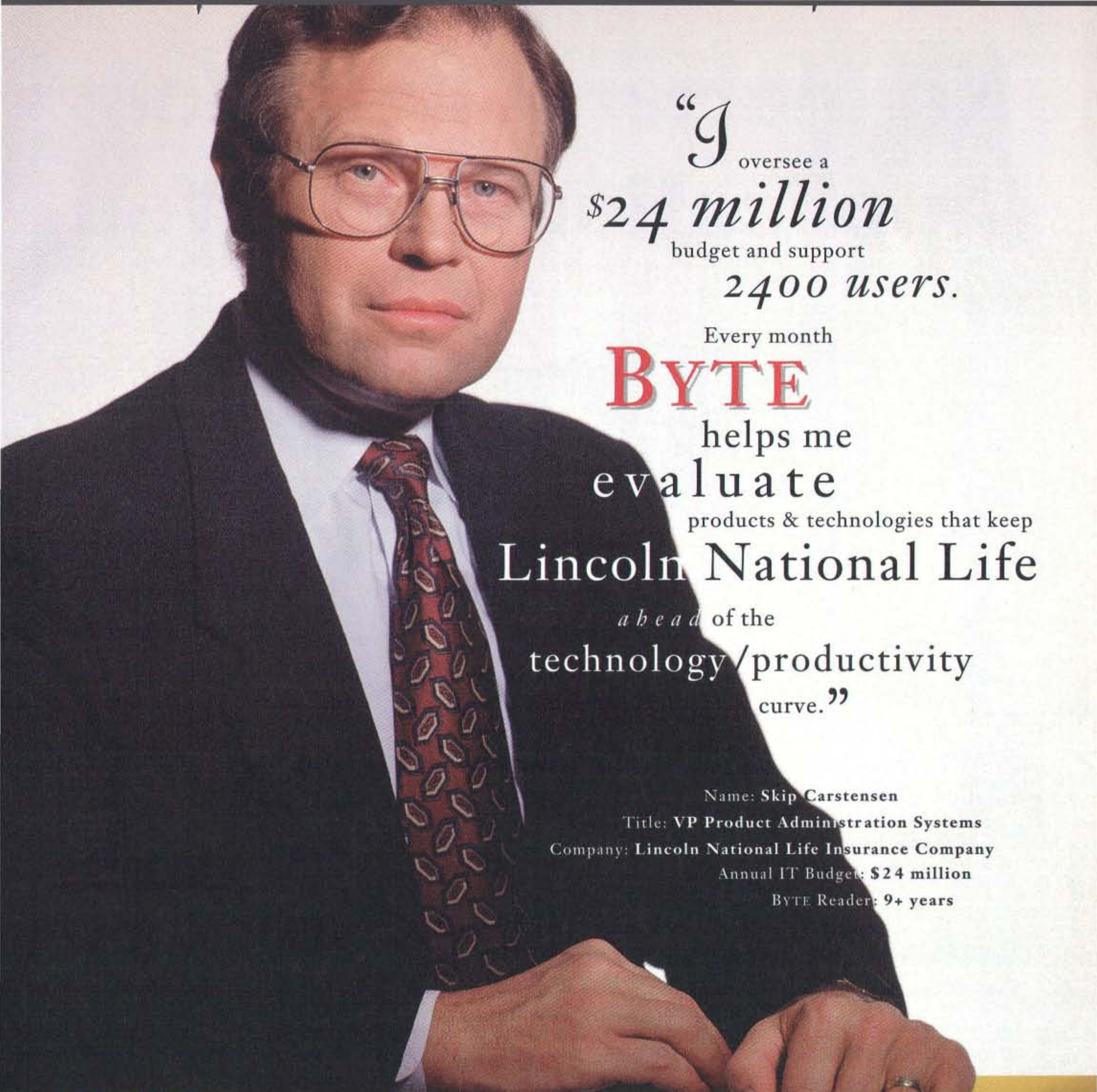
Contact: Syntegration, Chino, CA, (909) 464-9450; 73707.3331@compuserve.com.

Circle 1015 on Inquiry Card.

An analysis and presentation-graphics program, **Stanford Graphics 3.0** has been ported to Digital Equipment's Alpha systems running Windows NT. Enhancements include a Formula Visualizer, which graphically solves user-defined equations; custom line styles; speed improvements of 650 percent for data import and 150 percent for spreadsheet calculations; intelligent data axes for plotting time-series or financial data; and various graphics import and export options. $895.

Contact: Visual Numerics, Houston, TX, (800) 729-4723 or (713) 784-3131; http://www.vni.com.

Circle 1016 on Inquiry Card.



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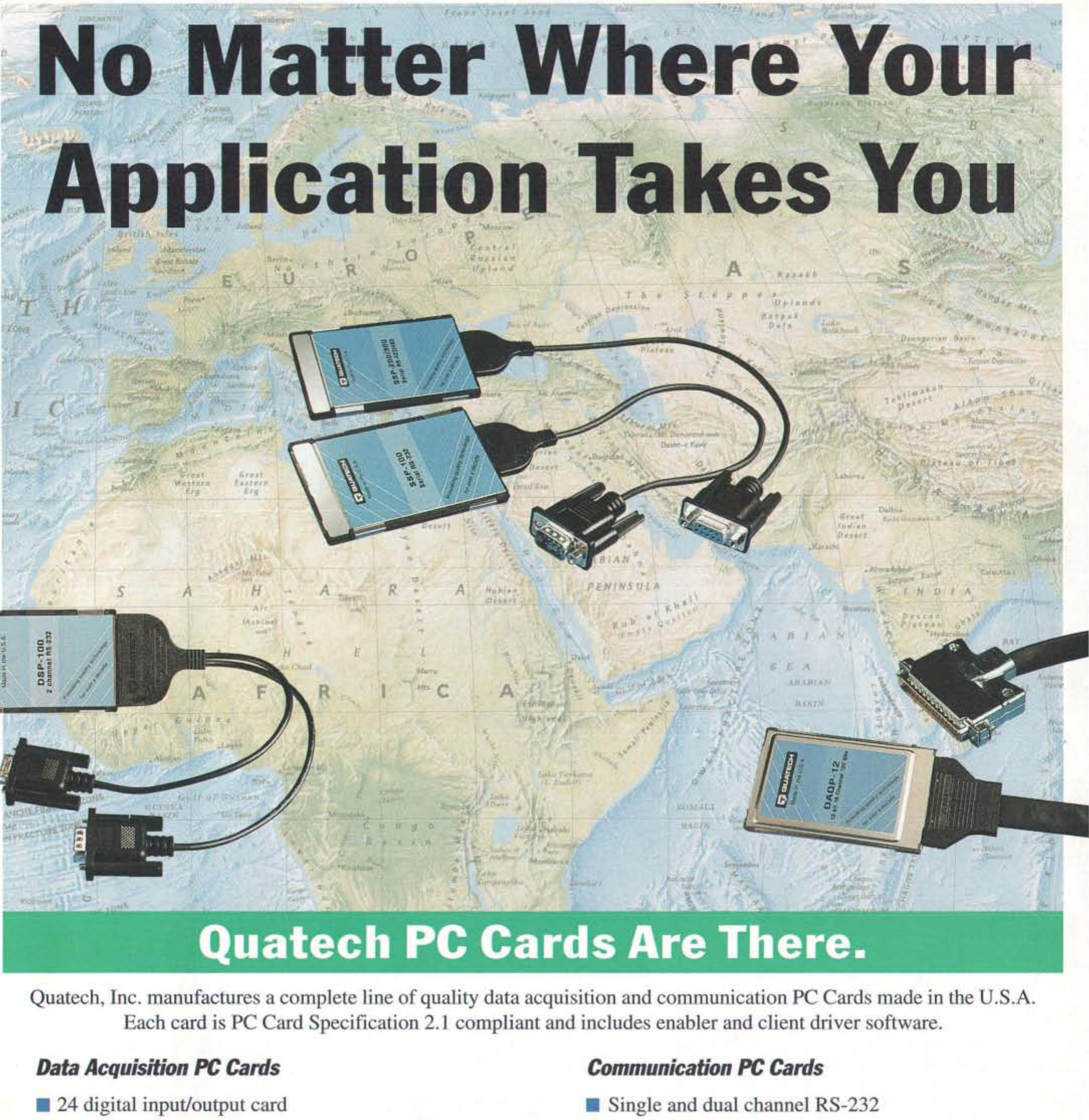

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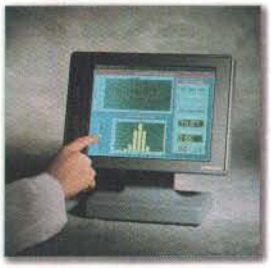

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Pentium 90MHz	9.5" True Color	720MB	$4359

T2130

Satellite T2110/T2130

- 10.4" Dual Scan & Active
- Built-in AC adapter - small, sleek design & reduced weight
- Integrated Accupoint - small, accurate & easy to use

Processor	Screen	HD	Price
486DX4/75	10.4" Dual Scan	330MB	$1979
486DX4/75	10.4" Dual Scan	500MB	2459
486DX4/75	10.4" Active	500MB	3059

Satellite T2100

- Built-in AC Adapter for easy connections
- 4MB/28MB memory
- 2 Type II or 1 Type III PCMCIA slots
- **FREE** Windows 95 Upgrade

Processor	Screen	HD	Price
486DX2/50	9.5" Mono	250MB	$1199
486DX2/50	8.4" Active	330MB	2399

T2110

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Versa 2000

- Lithium Ion battery technology
- VersaGlide touch-pad pointer – simple & accurate
- Built-in, upgradable 14.4 fax/modem (active models only)
- LOADS of **FREE** software preinstalled

Processor	Screen	HD	Price
486DX4/75	10.4" Dual Scan	350MB	$1999
486DX4/75	9.5" Active	350MB	2299*
486DX4/75	9.5" Active	350MB	2599
486DX4/75	9.5" Active	540MB	2799

**14.4 fax/modem not built-in*

Additional NEC Products

Chassis	Processor	HD	Price
NEC Ready Multimedia			
Minitower 5010	486DX4/100	540MB	$1499
Minitower 7020	Pentium 75	850MB	1799
Minitower 9010	Pentium 90	850MB	2099
Minitower 9510	Pentium 90	1.2GB	2499
Minitower 9520	Pentium 100	1.2GB	2799

Monitors priced separately

Versa 400

NEC Versa 4000

- Built-in CD-ROM drive! (Standard on some models, optional on others)
- Pentium 75 and Pentium 90 processors
- 256KB Level 2 Cache to optimize performance
- Unbelievable displays – 65K color Dual Scan, 16.8 million color Active (High resolution Active Matr displays available – 800x600 res.)
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- Multimedia docking station with outstanding Altec Lansing 4 speaker array

Processor	Screen	HD	Price
Pentium 75	10.4" Dual Scan	540MB	$3499
Pentium 75	10.4" Dual Scan	540MB	3799*
Pentium 75	10.1" Active	540MB	4199
Pentium 90	10.1" Active	810MB	4899*
Pentium 90	10.4" High Res.	810MB	5099

** Features built-in CD-ROM drive standard*

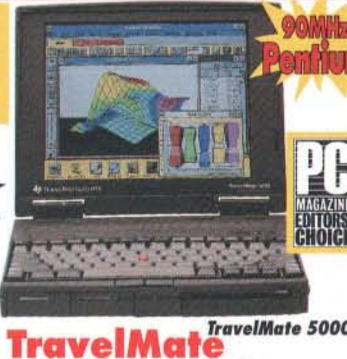
TEXAS INSTRUMENTS

Extensa 450

Extensa 450

- 10.4" Dual Scan & 9.5" Active display
- GlidePad pointing device
- Advanced battery pro
- Built-in infrared for no hassle printer connections

Processor	Screen	HD	Price
486DX4/75	10.4" Dual Scan	340MB	$1799
486DX4/75	9.5" Active	340MB	2399



TravelMate 5000

TravelMate 5000/5100

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- 10.5" Dual Scan display with 2MB Video RAM
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- 16-bit Sound Card, Speaker, Microphone & MIDI
- Upgradable hard drive - easily add more storage
- Built-In Dual Lithium Ion batteries
- Built-in infrared for no hassle printer connections

Processor	Screen	HD	Price
Pentium 75	10.4" Dual Scan	500MB	$3799
Pentium 75	10.4" Active	772MB	4499
Pentium 90	10.4" Active	1.2GB	5299

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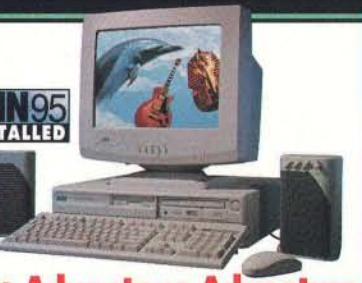

Ask about NEW Ascentia 950N Pentium 90MHz

Advantage Adventure

Additional Products from AST

Processor	Screen	HD	Price
Ascentia 950N WIN95 INSTALLED			
Pentium 75	10.4" Dual Scan	500MB	$ 3299
Pentium 75	10.4" Dual Scan	800MB	3589
Pentium 75	10.4" Dual Scan	1.2GB	4059
Pentium 75	10.4" Active	800MB	4719
Pentium 75	10.4" Active	1.2GB	5189
Ascentia 910N			
486DX4/75	10.3" Dual Scan	510MB	$2469
486DX4/75	10.3" Dual Scan	700MB	2649
486DX4/75	10.4" Active	510MB	3119
486DX4/75	10.4" Active	700MB	3199

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- Windows 95 keyboard for increased productivity
- AST Works II navigation software – featuring "SPOT"

Chassis	Processor	HD	Price
Desktop (612)	Pentium 75	850MB	CALL
Minitower (812)	Pentium 100	1.2GB	CALL
Minitower (814)	Pentium 100	1.2GB	CALL*
Minitower (818)	Pentium 133	1.6GB	CALL*

Monitors priced separately *16MB RAM standard

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Additional IBM® Notebooks

Processor	Screen	HD	Price
ThinkPad®755			
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486DX4/100	10.4" Active	810MB	5099
486DX4/100	10.4" Active	540MB	5649*
486DX4/100	10.4" Active	810MB	6099*
Pentium 75	10.4" Active	540MB	4749+
Pentium 75	10.4" Active	810MB	5199+
Pentium 75	10.4" Active	540MB	5799
Pentium 75	10.4" Active	810MB	6249
486DX4/100	10.4" Active LCD	540MB	6099
486DX4/100	10.4" Active LCD	540MB	7099*
486DX4/100	10.4" Active LCD	810MB	7549*

**Features Built-In CD-ROM drive*
+ Does not include built-in audio, telephony & modem

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NEW LOW PRICES! $ $ $

Processor	Screen	HD	Price
486DX2/50	10.4" Active	360MB	$2999
486DX2/50	10.4" Active	540MB	3299
486DX4/75	10.4" Dual Scan	360MB	3149
486DX4/75	10.4" Dual Scan	540MB	3449
486DX4/75	10.4" Active	360MB	3699
486DX4/75	10.4" Active	540MB	3999

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Contura 410
Product differs slightly from photo.

LTE Elite

Contura 420/430

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- Fast 486DX4/75 or 486DX4/100 processors
- Optical trackball – smoother & more reliable
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- Compaq, 3-year worldwide warranty

Processor	Screen	HD	Price
486DX4/75	10.4" Dual Scan	420MB	$2459
486DX4/75	10.4" Active	420MB	3029
486DX4/100	10.4" Dual Scan	720MB	2839
486DX4/100	10.4" Active	720MB	3499

LTE Elite

- 10.4" Active Matrix display
- Fast 486DX4/75 processor
- Built-in AC adapter - small, sleek design & reduced weight
- Upgradable hard drive - easily add more storage

Processor	Screen	HD	Price
486DX4/75	9.5" Dual Scan	340MB	$2739
486DX4/75	9.5" Dual Scan	510MB	2999
486DX4/75	10.4" Active	510MB	4159
486DX4/75	10.4" Active	810MB	4539

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HP OmniBook 5000

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Processor	Screen	HD	Price
Pentium 90	10.4" Active	1.2GB	$5579
Pentium 90	10.4" Active	1.2GB	6239*

*16MB RAM standard

WIN95 INSTALLED

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Processor	Screen	HD	Price
486DX2/50	8.5" Dual Scan	260MB	$2169
486DX4/75	8.5" Dual Scan	260MB	2599
486DX4/75	9.5" Active	260MB	3099

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HP LaserJet 4L printer (IBM, 4ppm, 300dpi)	499.99

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HP DeskJet 320 printer (portable)	$299.99
HP DeskJet 320 printer w/feeder	359.99
HP DeskJet 600 printer	289.99
HP DeskJet 600C printer	299.00
HP DeskJet 660C printer	389.99
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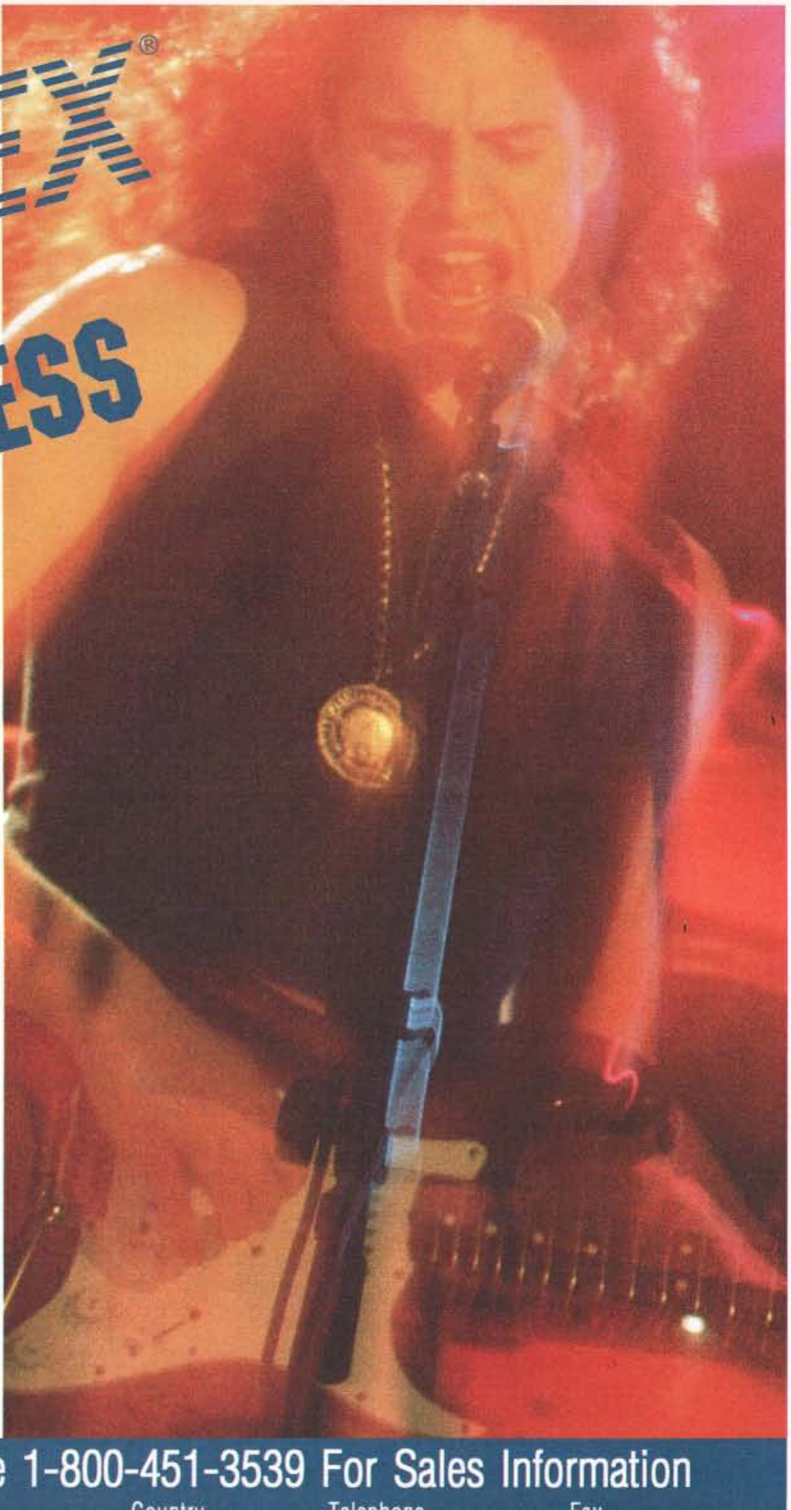

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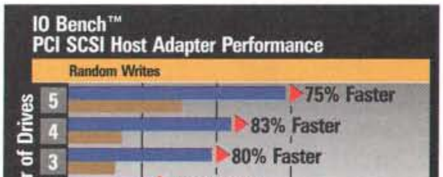

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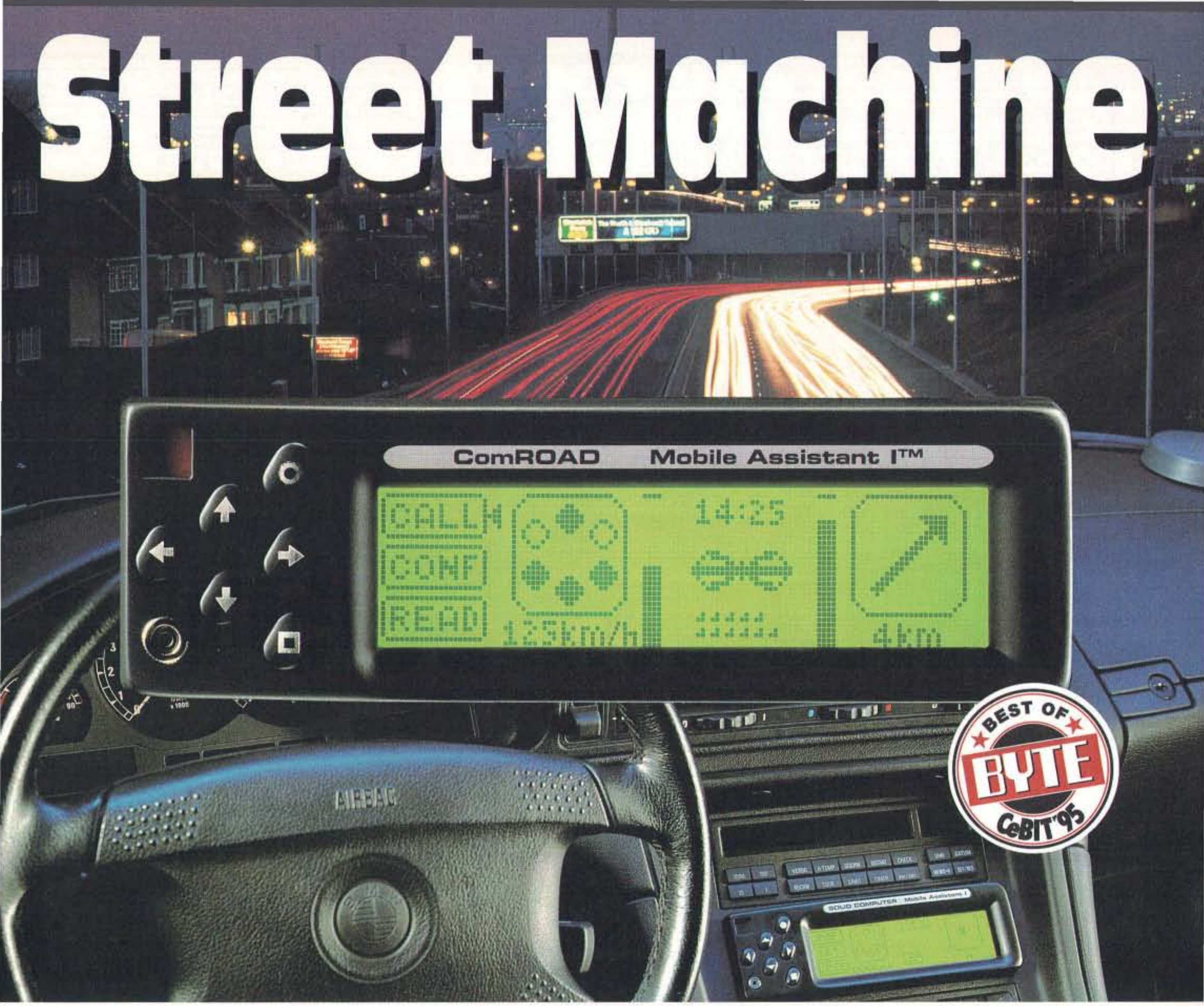

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DSP3210	2GB	9.5MS	SCSI	1149-1274
DSP5300	3GB	12MS	SCSI	1299-1324
DSP5400	4GB	12MS	SCSI	2479-2604

HEWLETT PACKARD

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
C3323A	1.05GB	10MS	SCSI	$599-764
C2490	2.1GB	8.9MS	SCSI	999-1154

Quantum

FACTORY NEW-2 YEAR WARRANTY				
MAVERICK IDE & SCSI-2 SERIES				**INT-EXT**
30540MVA	540MB	14MS	IDE	179-320
30540MVS	540MB	14MS	SCSI	189-314
LIGHTNING IDE & SCSI-2 SERIES				**INT-EXT**
30540LTA	540MB	11MS	IDE	$189-339
30730LTA	730MB	11MS	IDE	239-389
30540LTS	540MB	11MS	SCSI	199-324
30730LTS	730MB	11MS	SCSI	269-394
TRAIL BLAZER SERIES				**INT-EXT**
30420TRA	420MB	12MS	ATA-2	169-N/A
30420TRA	420MB	12MS	F.SCSI-2	179-304
30850TRA	850MB	12MS	ATA-2	249-N/A
30850TRA	850MB	12MS	F.SCSI-2	269-394
THUNDERBOLT SERIES				**INT-EXT**
30420LPA	420MB	12MS	ATA-2	189-N/A
FIREBALL SERIES				**INT-EXT**
30540FBA	540MB	12MS	ATA-2	189-N/A
30540FBS	540MB	12MS	F.SCSI-2	199-324
31080FBA	1.08GB	12MS	ATA-2	279-N/A
31080FBS	1.08GB	12MS	F.SCSI-2	399-554
EMPIRE FAST SCSI-2 SERIES				**INT-EXT**
EMP2100S	2.1GB	8.9MS	3.5"	889-1014
CAPELLA FAST SCSI-2 SERIES				**INT-EXT**
VP32210S	2.2GB	8.5MS	3.5"X1	769-974
ATLAS FAST SCSI-2 SERIES				**INT-EXT**
XP32150S	2.1GB	8MS	7200RPM	870-1024
XP34300S	4.3GB	8MS	7200RPM	1499-1724
GRAND PRIX SCSI-2 SERIES				**INT-EXT**
GP34301S	4.3GB	8.6MS	7200RPM	1099-1224
GRAND PRIX SCSI-2 SERIES				**INT-EXT**
GP34301W	4.3GB	8.6MS	7200RPM	1299-1424

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4MB X 9-60NS SIMM 9 CHIP	169
1MB X 9-100NS 9 CHIP SIMM	40
1MB X 9-80NS 3 CHIP SIMM	42
1MB X 9-80NS 9 CHIP SIMM	44
1MB X 9-70NS 3 CHIP SIMM	42
1MB X 9-70NS 9 CHIP SIMM	44
1MB X 9-60NS 3 CHIP SIMM	42
1MB X 9-60NS 9 CHIP SIMM	48
16MB X 9-70NS SIMM	595
16MB X 9-60NS SIMM	625
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256K X 9-70NS SIMM	15
256K X 9-60NS SIMM	18
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1MB X 8-80NS SIMM	40
1MB X 8-70NS SIMM	40
24MB X 8-80NS SIMM	145
4MB X 8-70NS SIMM	150
4MB X 8-60NS SIMM	155
30 PIN 9 BIT SIPPS	
1MB X 9-100NS SIPP	43
1MB X 9-80NS SIPP	49
1MB X 9-70NS SIPP	50
1MB X 9-60NS SIPP	51
256K X 9-80NS SIPP	19
256K X 9-70NS SIPP	20
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256X36-1MB-70NS	55
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1X36- 4MB-70NS/60NS MAJOR	175/185
2X36-8MB-70NS/60NS	330/350
2X36-8MB-70NS/60NS MAJOR	350/360
4X36-16MB-70NS/60NS	535/545
4X36-16MB-70NS/60NS MAJOR	650/660
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ST15150W	4.29GB	8MS	3.5"	1619

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486DX-33	125	PENTIUM 90	389	486DX4-120	213
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486DX-50	249	PENTIUM 120	760	486DX2-33	89
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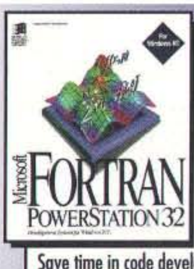

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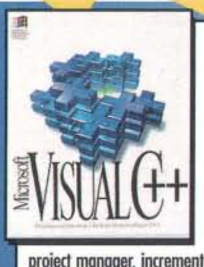

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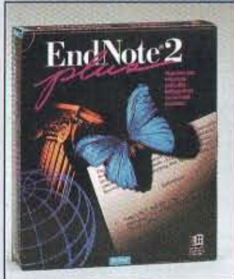

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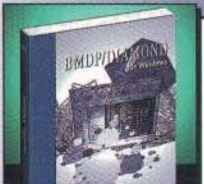

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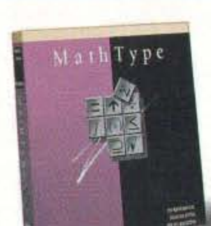

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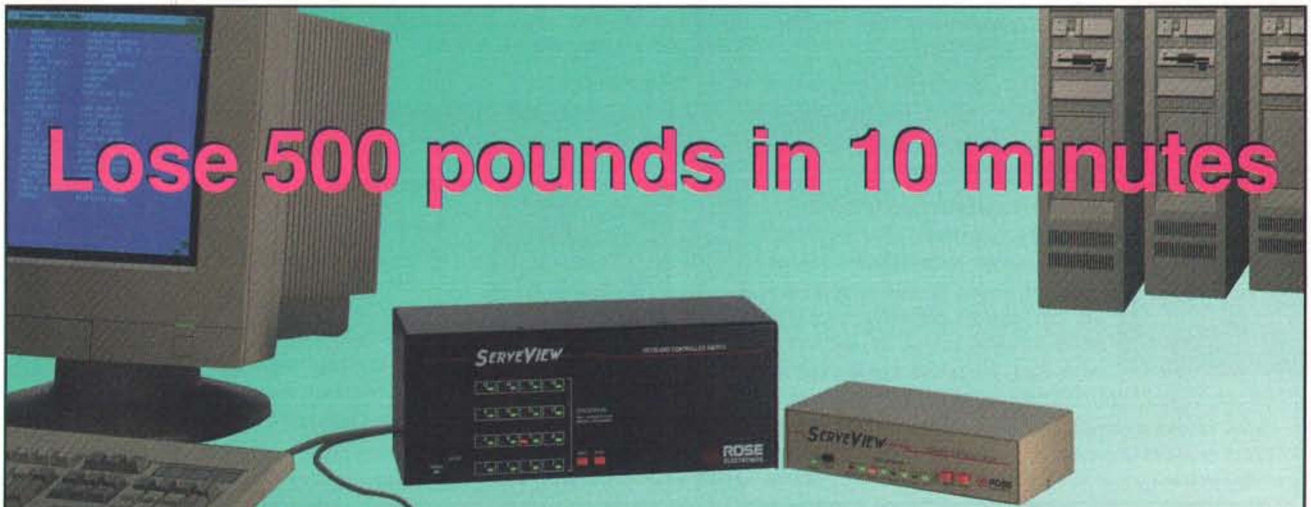

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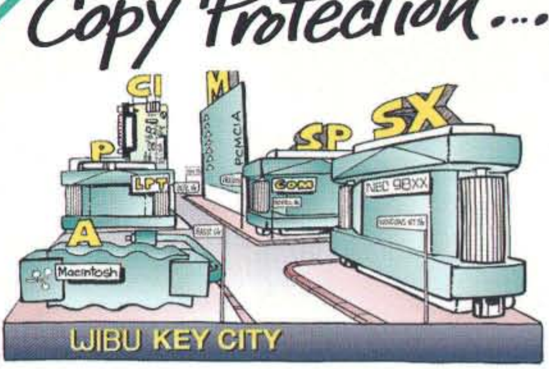

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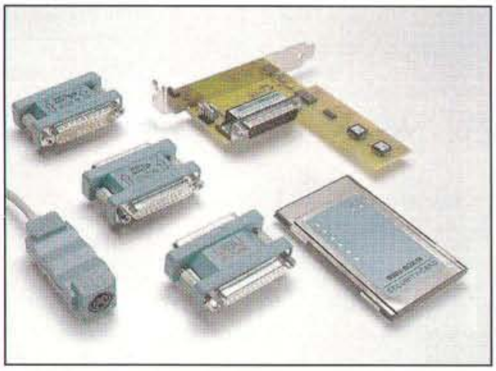

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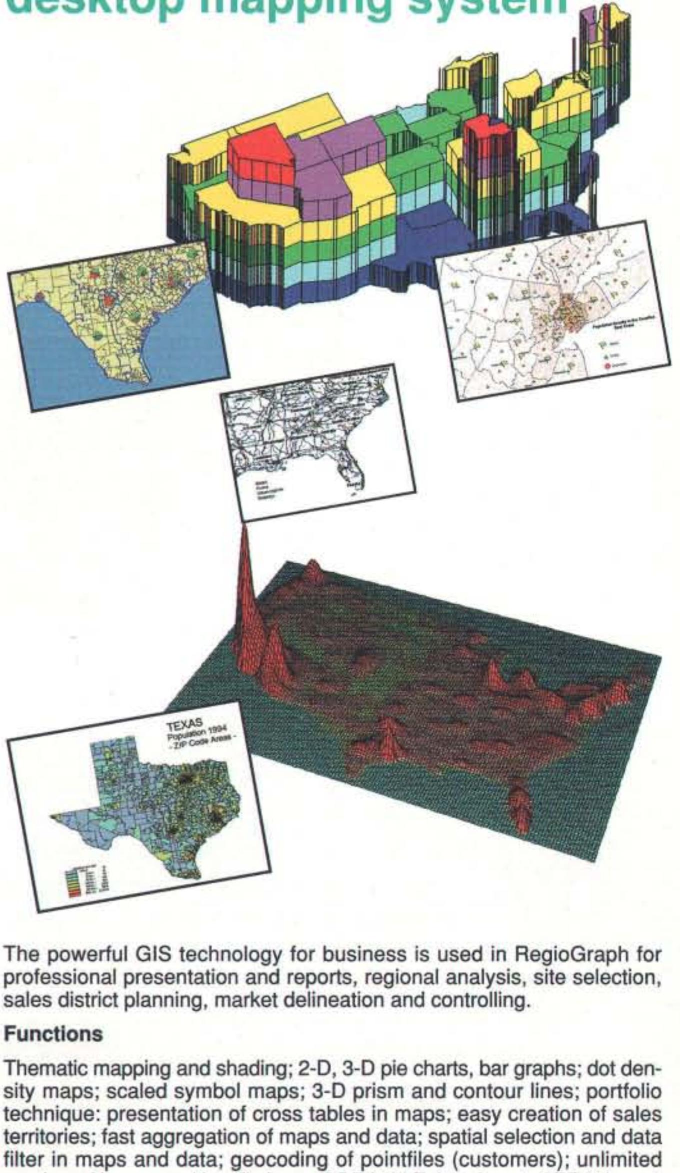

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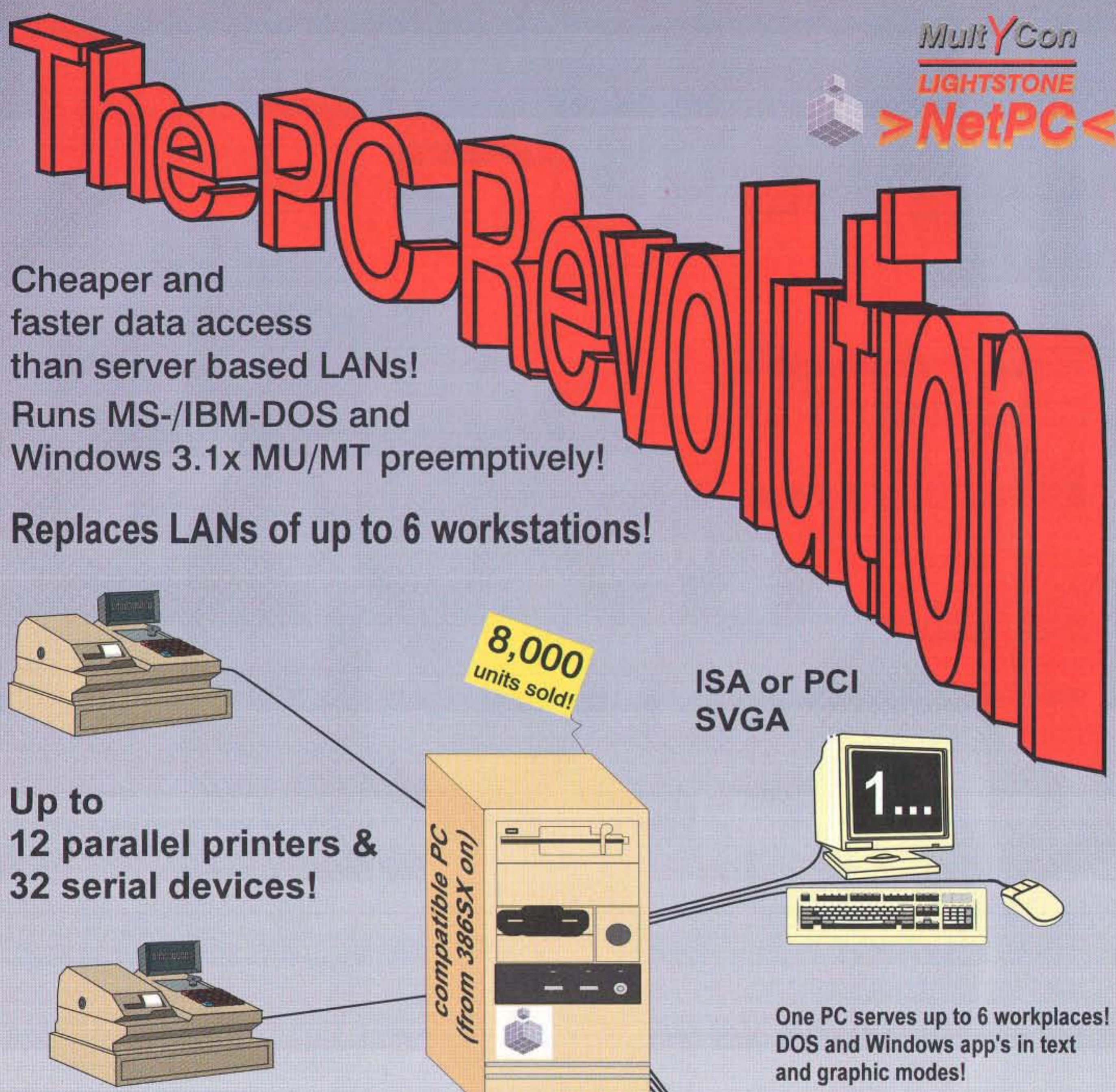

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30F5360 (2Meg)	30-286, 25-286, 50 MTHR BD	104.00
6450375 (1Meg)	80-041	79.00
6450379 (2Meg)	80-111, 311-121, 321, 081, 161	84.00
6451060 (4Meg)	80-A21, A-61, 80-A31, 80-111, 80-311	189.00
6450604/92G7196 (2Meg)	70-061, E61, 121, 50Z, 55SX, 65SX, P-70, 55LS, 65LS, X-Station 120 & 130, 35SX, 35LS, 40SX	99.00
6450608 (2Meg)	70-A21, A-61, B-21, B-61, 35SX, 35LS, 40SX, Val Pt, 325T	90.00
78X8955 (128K)	25	35.00
34F2933 (4Meg)	35SX, 40SX, 55SX, 65SX, 55LS, 65LS	169.00
87F9977/92G7199 (4Meg)	55SX, 55LS, 65SX, 40SX, 35SX, 35LS	169.00
1057035 (512K)	P/S1-286	49.00
92F9935 (2Meg)	P/S1 & P/S1/386SX-2121	109.00
92F9694 (4Meg)	P/S1 & P/S1/386SX, Model-2121	189.00
92G7200 (4Meg)	PSI Expert, Consultant, Willow	169.00
92G7201, 73G3131 (4Meg)	Value Point Performance, PC Server 4/66	169.00
92G7539 (4Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730	164.00
92G7541 (8Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730	309.00
92G7543 (16Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730	559.00
92G7545 (32Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730	1149.00
73G3132/92G7203 (8Meg)	Value Point Performance, PC Server 4/66	349.00
60G1622/92G7204 (16Meg)	Value Point Performance, PC Server 4/66	609.00
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6450128/92G7200 (4Meg)	57SX, 90, 95, P-75, 57SLC, 56, 56SLC, P/S1, 386SX, Mod-2123, 2133, 2155, Val Pt 77, 486DX2, 486SX, SVR85 Value Point 77 486DX2, 486SX, SVR 85	169.00
6450129/92G7428 (8Meg)	35SX, 40SX	348.00
6450130/92G7202 (8Meg)	56, 57, 57SX, 90, 95, P-75, 57SLC Value Point 77 486DX2, 486SX, SVR 85	349.00
6451158/92G7208 (4Meg ecc)	486, 95XP; 95A (install in pairs)	199.00
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66G0095 (16Meg)	Thinkpad 750, C	629.00
66G0094 (4Meg)	Thinkpad 755, 360, 355, 340, 450	179.00
66G0094 (8Meg)	Thinkpad 755, 360, 355, 340, 450	349.00
66G0094 (16Meg)	Thinkpad 755, 360, 355, 340, 450	619.00
8189098 (4Meg)	Thinkpad 500, 510CS (3.3 volt)	189.00
8189099 (8Meg)	Thinkpad 500, 510CS (3.3 volt)	369.00
79F0999 (2Meg)	LX40, N33SX, PS Note	103.00
79F1000 (4Meg)	LX40, N33SX, PS Note, Tkpd 350, 350c, PS Note 425	189.00
79F1001 (8Meg)	LX40, N33SX, PS Note	349.00
Hard Drive (524Meg, 710 Meg)	Thinkpad 750, 755, 360, 355	829/929
(4Meg/16Meg)	Thinkpad 755 Dimm Modules	199/749
(4Meg/16 Meg w/Adap	Thinkpad 755	269/839
60G0378 (8Meg)	Thinkpad 350, 350c, PS Note 425	339.00
60G0379 (16Meg)	Thinkpad 350, 350c, PS Note 425	569.00
92F8804 (2Meg)	N45SL	109.00
92G7259 (4Meg)	Thinkpad 701C, CS, Butterfly	189.00
92G7261 (8Meg)	Thinkpad 701C, CS, Butterfly	369.00
92G7263 (16Meg)	Thinkpad 701C, CS, Butterfly	649.00
4Meg/8Meg/16Meg (730T only)	Thinkpad 340, 730T	219/359/709
8Meg/16Meg	Thinkpad 820	390/729
4Meg/8Meg/16Meg/32Meg	Thinkpad 850	193/399/719/1439
4Meg/8Meg/16Meg/32Meg	PC300 Pentium	179/339/629/1259

COMPAQ MEMORY MODULES

MODEL	AMT. UPGRADED	CMPQ PART #	PRICE
DeskPro 386/33, 386/33L, 486/25, 486/33L, 486/50L, System Pro	2Meg Module	115144-001	99.00
	8Meg Module	116561-001	349.00
	32Meg Module	116568-001	1399.00
DeskPro 386/33L, 486/33L	(Exp Bd)	116569-001	279.00
DeskPro 386/25, 386/20	1Meg Module	113131-001	79.00
	4Meg Module	113132-001	199.00
DeskPro 386S-16MHz	1Meg Exp Bd	113633-001	148.00
	4Meg Exp Bd	113634-001	279.00
	1Meg Module	113646-001	79.00
	4Meg Module	112534-001	199.00
DeskPro 386/20E	1Meg Exp Bd	113644-001	149.00
DeskPro 386/25E	4Meg Exp Bd	113645-001	279.00
	1Meg Module	113131-001	79.00
	4Meg Module	113132-001	199.00
DeskPro 286N, 386N, 386SX20, all "M" series, sytem LT series, all "T" series	1Meg Module	118688-001	59.00
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	8Meg Module	128877-001	347.00
M Series Exp Bd	0-64Meg	129160-001	189.00
DeskPro 386/16	1Meg Kit	108071-001	99.00
	4Meg Kit	108072-001	299.00
	1-2Meg Exp Bd	108069-001	239.00
	4-8Meg Exp Bd	108070-001	437.00
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Prosignia 5/60	16Meg Kit	149949-001	676.00
Proliant 100 5/60	32Meg Kit	149912-001	1420.00
Proliant 2000 4/30, 5/66	64Meg Kit	149913-001	2476.00
Proliant 4000 4/50, 5/66	128Meg Kit	149914-001	5076.00
Prolinea 386 3/25S, 3/25ZS	2Meg	141738-001	90.00
	8Meg	141742-001	298.00
Prolinea 486 4/25S, 4/33, 4/50, 4/66, CDS Enhanced Prolinea, Prosario series	2Meg	141683-001	95.00
	4Meg	141684-001	169.00
	8Meg	141685-001	339.00
Prosignia PC Server, 486/33, 486 DX2/66	8Meg	141685-001	339.00
	16Meg	149320-001	629.00
	32Meg	149147-001	1289.00

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LTE/286	4Meg Bd	117081-003	179.00
LTE/386S/20	4Meg Module	121125-002	219.00
LTE LITE/20, 25, 25C	4Meg Module	129769-002	219.00
LTE LITE/20, 25, 25C	8Meg Module	129769-003	439.00
LTE LITE/20, 25, 25C	16Meg Module	129769-004	669.00
LTE LITE 425C/33C/25E/25L	4Meg Module	142337-002	189.00
LTE LITE 425C/33C/25E/25L	8Meg Module	142337-003	349.00
LTE LITE 425C/33C/25E/25L	16Meg Module	142337-004	619.00
SLT/286	4Meg Module	110237-001	199.00
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Contura 420, 430	4Meg/8Meg/16Meg/20Meg		219/379/719/879
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T2000SXE/2200SX/T1800, 1850, C	4Meg	PC-PA2001U	189.00
T2000SXE/2200SX/T1800, 1850, C	8Meg	PC-PA2002U	359.00
T2100, 2105, 2150	4Meg/8Meg		189/379
T2100, 2105, 2150	16Meg/24Meg		729/1134
T4400SX, SXC T6400, T6600	4Meg	PC-PA2004U	189.00
T4400SX, SXC T6400, T6600	8Meg	PC-PA2005U	379.00
T4400SX, SXC T6400, T6600	16Meg	PC-PA2010U	689.00
T4500, C, T4600, T4700, T1900, C, T1910, T1952 (3.3 v)	4Meg	PC-PA2012U	189.00
T4500, C, T4600, T4700, T1900, C, T1910, T1952 (3.3 v)	8Meg	PC-PA2013U	349.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	16Meg	PC-PA2014U	652.00
T4700, 4800, 4850 (Hard Drive)	524Meg/710Meg		799/1098
T3400CT, T2400, T3600	4Meg	PC-PA2019U	189.00
T3400CT, T2400, T3600	8Meg	PC-PA2020U	359.00
T3400CT, T2400, T3600	16Meg	PC-PA2021U	619.00
T3400CT	32Meg		1549.00
T3100SX	2Meg	PC15-PA8308U	109.00
T3100SX	4Meg	PC15-PA8310U	189.00
T3200	3Meg	PC6-PA7137U	170.00
T3200SX	2Meg	PC12-PA8307U	119.00
T3200SX	4Meg	PC12-PA8909	199.00
T5200/T8500	2Meg	PC10-PA8304U	114.00
T5200/T8500	8Meg	PC10-PA8313U	419.00
T600, 610, CT	4Meg/8Meg/16Meg		Call

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ACER 763, 765, 782, 784, 786, 787,	4Meg/8Meg/16Meg		199/379/719
ACER 750	4Meg/8Meg/16Meg		189/379/629
ALR Venture	4Meg	12407980	249.00
Altima Virage	4 Meg/ 16 Meg		199/679
Altima Virage II	4Meg/8Meg/16Meg		199/369/622
AST Advantage Adventure 4066D, 6066D, 8066D	8Meg/16Meg/32Meg/64Meg		189/409/599/1262
AST Ascentia 900N, 800N	4Meg/8Meg/16Meg		189/379/629
AST Ascentia 950	8Meg/16Meg		419/759
AST Bravo & Explorer	4Meg/16Meg	501255-001, -002	189/679
AST Bravo MS-L P90	8Meg/16Meg/32Meg/64Meg		379/759/1249/2599
AST Notebook Prem Exec 386SX/20/25/25L	4Meg	500814-003	189.00
AST Power Exec 3/25C, 425EL, 425SL	4Meg/16Meg	501166-001, -003	199/629
AST Power Exec 4/33SL	4Meg/16Meg	501318-001.002	194/679
AT&T Globalyst 200	4Meg/8Meg/16Meg		199/389/679
AT&T Safari NSX/20	4Meg	PEC 37651	259.00
Austin DX4, DX2, SX2, SX Series	4Meg/16Meg		199/699
Bondwell B310, Plus	1Meg	23050-09100	69.00
Bondwell B310V, SX	1Meg/4Meg		109/229
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Canon Innova 486	2Meg/4Meg/8Meg		109/209/449
Canon Innova 486-10	4Meg/16Meg		189/639
Canon Notejet 486	4Meg/8Meg		199/389
Canon Notejet DX4/75	4Meg/8Meg/16Meg		209/379/679
Chaplet 486	4Meg/16Meg		199/679
Chicony NB5	4Meg/16Meg		199/679
Compuadd 425TX Notebook	4Meg/16Meg		199/699
DEC HiNote	4Meg/8Meg/16Meg		199/379/669
Dell Latitude M, MC, MCX	4Meg/8Meg/16Meg		189/379/639
Dell Latitude XP, 475, 4100, 4100CX	4Meg/16Meg		199/639
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DTK 4T100P Notebook	4Meg/8Meg/16Meg		189/369/639
Epson ActionNote 650, 650c	4Meg/8Meg/16Meg		209/399/659
Epson ActionNote 700, 700c, 700cx	4Meg/16Meg		199/639
Epson ActionNote 880, 880c	4Meg/8Meg/16Meg/20Meg		Call/389/669/Call
Epson ActionNote 4000 Notebook	6Meg		279
Epson ActionNote 4LC/25, 4LC/33, 4SLC/2-50	2Meg/6Meg		119/279
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Gateway 2000 Colorbook 4/33	4Meg/16Meg		199/619
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Gateway 2000 486 Handbook or Liberty	4Meg/16Meg		199/679
HP Omnibook 300, 480, 425	2Meg/4Meg		129/219
HP Omnibook 530, 600	4Meg/8Meg/12Meg		189/379/549
HP Omnibook 4000	4Meg/8Meg/16Meg		199/379/649
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Midwest Micro Elite Sndbk SX33, DX2-50, DX4-75, DX4-100	4Meg/8Meg/16Meg		199/389/629
Midwest Micro Elite Sndbk Plus D5-75, D5-90	4Meg/8Meg/16Meg		199/389/629
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Sharp 6781, 6881, 6785, 6700, 6800, 6741	2Meg/4Meg		109/199
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Zeos 386SX Notebook (not the + version)	2Meg		109.00
Zenith Master Sport 386SX	2Meg	ZA-300-1	114.00
Zenith Master Sport SL, SLE, 600, 620, 625NL	2Meg	ZA-4-4	104.00
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Canon LBP 430	–	–	69	–	–	–	189	–	–	–	–	–
Canon LBP 860	–	–	–	99	–	–	179	–	–	349	669	1249
Canon LBP4, 4Lite, 4plus	–	–	159	219	–	–	–	–	–	–	–	–
Epson 6000, Action Laser	–	–	–	139	–	–	229	–	–	–	–	–
Epson Action Laser 1100, 1600	–	–	69	99	–	–	189	–	–	379	599	–
Epson Action Laser II	–	–	89	–	208	–	–	327	–	–	–	–
Epson 8000, 1800, 4000, 4100, 4300	–	–	89	–	208	–	–	327	–	Call	Call	Call
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HP 4, 4M, 4SI, 4SIMX, 4P, 4MP	–	–	–	89	–	–	109	–	–	349	–	–
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HP 3SI	–	–	69	–	–	–	169	–	–	349	–	–
HP 4SI	–	–	–	89	–	–	175	–	–	349	–	–
HP 5P	–	–	–	89	–	–	155	–	–	305	539	–
HP Design Jet 600, 650, 200	–	–	–	89	–	–	175	–	–	349	–	–
HP Deskjet 500, 500C, 510, 550,560	–	55	–	–	–	–	–	–	–	–	–	–
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IBM Laser 4039, 4079	–	–	–	96	–	–	169	–	–	350	–	–
Konica LP-3110	–	–	119	189	239	–	–	–	–	–	–	–
NEC 90, 290	–	–	–	139	–	–	–	–	–	–	–	–
NEC 95, 97	–	–	–	98	–	–	–	–	–	–	–	–
Oki 400	–	–	–	104	–	–	–	–	–	–	–	–
Oki 400E, 400EX, 410E, 410EX	–	–	135	189	–	–	–	–	–	–	–	–
Oki 830, 840	–	–	–	109	–	–	–	–	–	–	–	–
Packard Bell PB 9500	–	–	–	139	–	–	227	–	–	–	–	–
Packard Bell 9815	–	–	–	159	–	–	269	–	–	–	–	–
Panasonic 4420/4450I	–	–	–	129	–	–	229	–	–	–	–	–
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Panasonic 4400/5400	–	–	89	129	–	–	229	–	–	–	–	–
Panasonic 4440, 5410	–	–	109	179	–	–	Call	–	–	–	–	–
Sharp 9400, 9460, 9600, 9700E	–	–	89	149	–	–	249	–	–	–	–	–
Sharp 9500, E, H, 9700, H	–	–	109	–	–	–	279	–	–	–	–	–
TI XL/PS17/PS35	–	–	49	–	–	–	–	–	–	–	–	–
TI Microlaser Pro E, Powerpro, Pro 600	–	–	89	139	–	–	229	–	–	429	–	–
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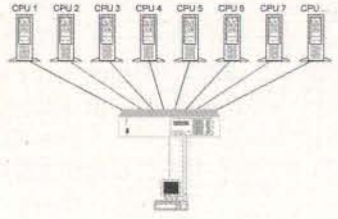

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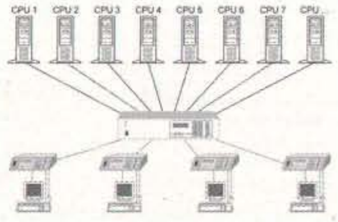

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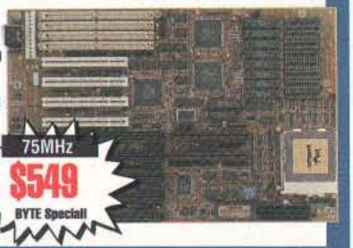

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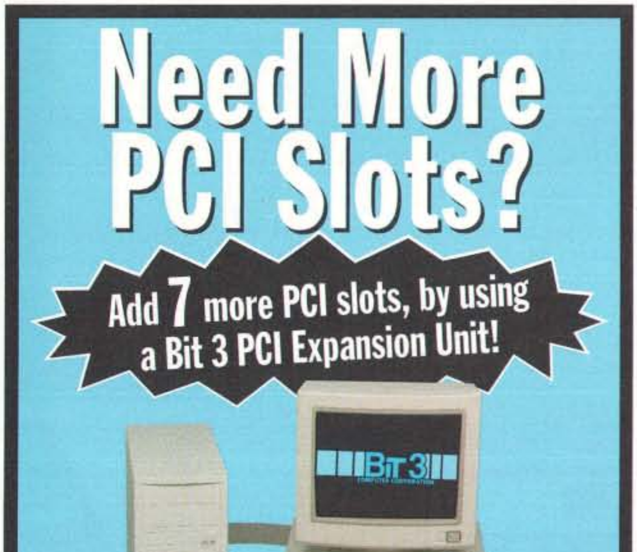

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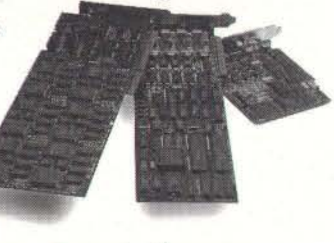

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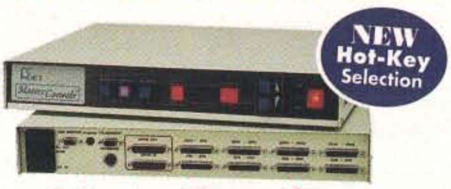

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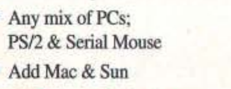

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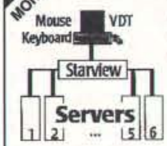

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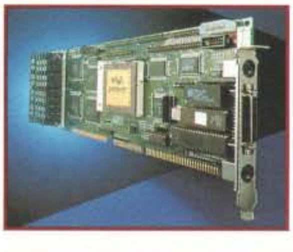

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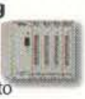

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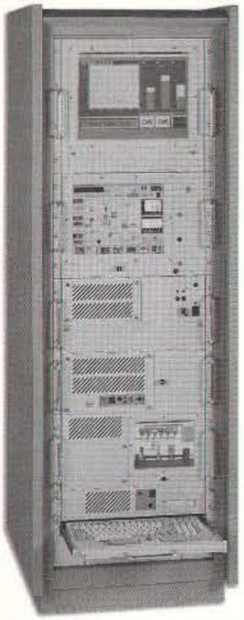

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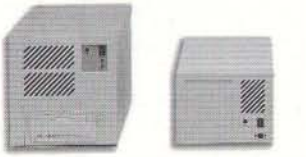

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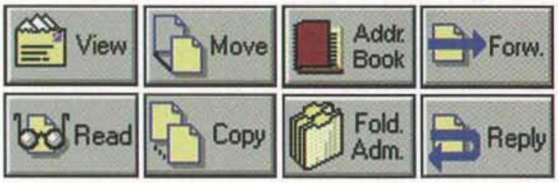

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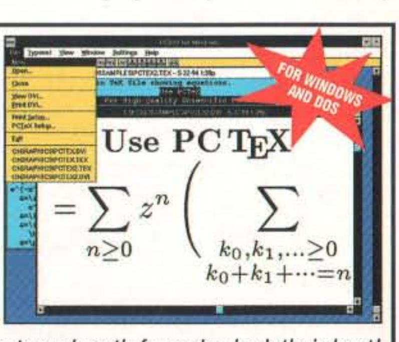

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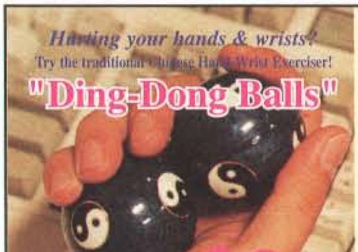

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63	AMERICAN POWER CONVERSION	32-33	800-800-4APC dpt A2
*	AMERICAN POWER CONVERSION	32A-B	401-788-2727**
178-179	ANGLE TECHNOLOGY INC	217	800-858-2173
*	ANTHRO CORP	108	800-325-3841
200-201	APPRO INTERNATIONAL INC	231	800-927-5464
136	ARTECON	172	800-872-2783
180	ASHTEK INC	209	800-801-9400
129	AT&T GLOBAL INFORMATION SOLUTIONS (N.A.)	56-57	800-447-1124 ext 1151
525-526	AXIS COMMUNICATIONS (INT'L)	104	+46 46 140500
	B		
132	BBN SOFTWARE PRODUCTS (N.A.)	82	800-331-2266 ext 130
64-65	BELL & HOWELL INC (INT'L)	76	708-675-7600
64-65	BELL & HOWELL INC (N.A.)	76	800-SCAN-494
245	BIT3 COMPUTERS	230	612-881-6955
450	BIX	249	800-695-4775
218-219	BOXLIGHT CORP	235	800-762-5757
*	BUSINESS SOFTWARE ALLIANCE	186	
*	BUSINESS WEEK (INT'L)	56	
*	BYTE BACK ISSUES (INT'L)	48IS 18	
*	BYTE EDITORIAL SURVEY	134	
*	BYTE EURODECK (INT'L)	82	603-924-2533
*	BYTE MOBILE OFFICE SWEEPSTAKES (U.S.)	183	
*	BYTE NETWORKING ON DISK	166	
66	BYTE ON CD ROM	126	
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*	BYTE REPRINTS	136	603-924-2525
*	BYTE SUB MESSAGE	170	
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*	BYTE SUB MESSAGE	48IS 26	
*	BYTE SUBSCRIBER SERVICE	48IS 28	
*	BYTE WAREHOUSE	171	
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127	CALIFORNIA PC PRODUCTS INC	182	800-394-4122
229-230	CAMELEON TECHNOLOGY INC	234	800-440-7466
118	CARDIFF SOFTWARE	168	619-931-4500
547-548	CASPER	48IS 26	+45-57-67-3000
*	CATHAY-WAVE	238	800-928-3001
*	CHEMPUTER (INT'L)	28-29	+49-69-71407-0
540-541	COMBYTE INC	CIV	303-229-0660
*	COMPAQ SERVERS (N.A.)	110-111	800-664-9888
503-504	COMPEX INC (INT'L)	93	714-630-7302
501-502	COMPEX INC (INT'L)	135	714-630-7302
67	COMPUSERVE	89	800-487-4838
*	COMPUSERVE	88A-B	800-487-4838
148	COMPUTER DISCOUNT WAREHOUSE	202-203	800-959-4CDW
236-237	COMPUTER GATE	230	408-730-0673
*	COMPUTER PROF'S BOOK SOCIETY (N.A.)	185	614-759-3666
*	COMPUTER PROF'S BOOK SOCIETY (N.A.)	184A-B	614-759-3749**
*	COMPUTER PURCHASER'S HELP LINE	238	900-976-8723
505	COMPUTER QUICK	48IS 12	415-861-8330
149	COMPUTERLANE UNLIMITED	228	800-526-3482
68	COREL CD OFFICE COMPANION	41	613-728-0826 ext 3080
69	COREL DRAW 6	115	613-728-0826 ext 3080
233-234	CORPORATE UPGRADES	234	800-240-6190
113	CREATIVE LABS INC	23	800-998-5227
150-151	CYBEX CORP	205	205-430-4030**
152-153	CYBEX CORP	219	205-430-4030**
506-507	CYBEX CORP (INT'L)	CIII	205-430-4030**
	D		
*	DATA ACCESS CORP	208	800-451-3539
*	DATA COMMUNICATIONS	224NE 2-3	
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*	DATA COMMUNICATIONS (INT'L)	38-39	
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154	DATALUX CORP	204	800-DATALUX
*	DATAPRO	158	
*	DELL COMPUTER CORP (N.A.)	CIII	800-766-4400
*	DELL COMPUTER CORP (N.A.)	CIV	800-759-1260
*	DELL COMPUTER CORP (N.A.)	28-29	800-766-3300
*	DELL COMPUTER CORP (N.A.)	99	800-822-3383
*	DELL COMPUTER CORP (N.A.)	158-159	800-825-6459
*	DELL COMPUTER CORP (N.A.,FORTUNE 1000)	CIII	800-866-6095
*	DELL COMPUTER CORP (N.A.,FORTUNE 1000)	CIV	800-825-9911
171	DESIGNER CHECKS	227	800-239-4087
533-534	DISTINCT CORP	48IS 16	408-366-8933
155	DISTRIBUTED PROCESSING TECHNOLOGY	212	407-830-5522
	E		
181-182	ELSNER TECHNOLOGIES (U.S.)	225	800-243-2228
215	EMATEK GMBH	237	+49 221 529666
551-552	E-TECH (INT'L)	183	+886-35-777751**
510	EUTRON	48IS 20	+39 35 201003
	F		
531	F & H SIMULATIONS (INT'L)	21	+31 13 427 516**
511-512	FAST (HARDLOCK)	48IS 7	+49-89-539800-20
529	FINSON (INT'L)	151	+39-2-6698-7036
523	FIRST INTERNATIONAL COMP	48IS 2	+886-2-718-2782**
156-157	FIRST SOURCE INT'L	220	714-448-7750
539	FISKARS POWERS SYSTEMS	48IS 9	+358 0 452661
72	FRAME TECHNOLOGY (N.A.)	21	800-U4FRAME ext 640
70-71	FRONTIER TECHNOLOGIES	184	800-929-3054
*	FUTURE MICRO INC	214	714-622-9137
216	FUZIWARE INC	238	800-472-6183
	G		
184	GAGE APPLIED SCIENCES INC	232	514-337-6893
*	GATEWAY 2000	42-45	800-846-2058
*	GATEWAY 2000	162-163	800-846-4289
238-239	GLOBETEK	230	800-229-4640
204-205	GRANITE DIGITAL	233	510-471-6442
513	GREY MATTER LTD	48IS 10	+44-(0)1364-53071
535-536	GVC CORP (INT'L)	143	+886-2-704-0338**
	H		
*	HEWLETT-PACKARD	37	800-964-1066
185	HIGH RES TECHNOLOGIES INC	233	416-497-6493 ext 106
186	HOOLEON CORP	234	520-634-7515
	I		
*	IBM APPLICATIONS DEVELOPMENT	59	800-3-IBM-OS2 ext SA034
*	IBM DATA MANAGEMENT (N.A.)	38-39	800-IBM-3333 ext GA061
*	IBM OS/2 (N.A.)	24-25	800-IBM-3333 ext EA100
*	IBM PERSONAL POWER PC (N.A.)	10-11	800-IBM-4FAX #8133643
133	IBM SERVERS (N.A.)	74-75	800-IBM-3333 ext FA179
222-223	ICL (EMBLA)	236	703-648-3326**
*	IDT	237	800-743-4343
210	IERC	230	818-842-7277
549-550	INFOCUS (INT'L)	99	+31-2503-23200
187	INTEGRAND RESEARCH	232	209-651-1203
73	INTEGRIX INC	175	800-300-8288
*	INTEL CORP	18-19	800-538-3373
74-75	INTERGRAPH CORP	90	800-291-9909
518-519	INTERGRAPH CORP	48IS 15	205-730-5499
188	IO TECH	233	216-439-4091
	J		
*	JDR MICRODEVICES	229	800-538-5000
	K		
189	KILA	232	303-444-7737
76-77	KINGSTON TECHNOLOGY	95	714-435-2600
78-79	KINGSTON TECHNOLOGY	157	714-438-1850
170	KLEINMANN GMBH	223	+49-7128-9292-92**
	L		
166-167	L A TRADE	226	800-433-3726
190	LAHEY COMPUTER SYSTEMS	237	800-548-4778
121	LANSOURCE TECHNOLOGY	141	416-535-3555
181-182	LIGHTSTONE SYSTEMS GMBH (INT'L)	225	+49-5643-9801-22**
560-561	LOGIC PROGRAMMING ASSOCIATES	48IS 22	800-949-7567
	M		
169	MACON	223	+49-7254-983-290**
527	MANNESMANN TALLY	48IS 23	+44 (0) 1734 788711
139-140	MAXTECH CORP (N.A.)	143	201-579-3630
*	MCGRAW-HILL COMPANIES (INT'L)	110	
545-546	MDI SYSTEMS LTD	48IS 27	+44(0)1368 850678
128	MEGAHERTZ CORP (N.A.)	151	800-LINKING ext 4324
544	MESSE MUENCHEN GMBH (SYSTEMS 95)	48IS 13	+49-89-5107-506
*	MICRO 2000	210	800-864-8008
250-251	MICRO 2000	211	800-864-8008
246	MICRO ALLIANCE	235	619-598-1900
537-538	MICRO DIRECT INT'L	48IS 14	415-325-3178
158-159	MICRO SOLUTIONS COMP PROD	213	800-295-1214
80-81	MICROGRAFX	73	800-877-3040
*	MICROGRAFX	193	800-357-7255
164	MICRO-INTERNATIONAL INC	218	800-967-5667
114	MICRON COMPUTER	CII-1	208-465-3434
*	MICROSOFT CORP	2-5	
*	MICROSTAR LABORATORIES	233	206-453-2345
*	MICROWAY	144	508-746-7341
528	MITAC INTERNATIONAL CORP (INT'L)	159	+886-2-501-4265**
82	MOTOROLA	121	800-894-7353
*	MOTOROLA	100-101	
*	MOTOROLA	102-103	
144-145	MRT (INT'L)	125	+47-638-92020
144-145	MRT (U.S.)	125	603-465-2830
	N		
191	NATIONAL INSTRUMENTS	233	512-794-0100
*	NEC	14-15	
83	NSTL	169	800-220-NSTL
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217	OBJECT MANAGEMENT LAB	238	800-6789-OML
514-515	OLIVETTI S.P.A. (INT'L)	10-11	+39-2-48361
516-517	OLIVETTI S.P.A. (INT'L)	24-25	+39-125-52
524	ON TIME MARKETING	48IS 22	+49-40-437472
252-253	ORCHESTRA MULTISYSTEMS	224	800-237-9988
*	OSBORNE MCGRAW-HILL	194-195	800-822-8158
	P		
84	PANASONIC COMMUNICATIONS & SYSTEMS	149	800-742-8086 ext PD
243	PANELIGHT	235	800-726-3599
85	PASSPORT DESIGNS INC (N.A.)	135	415-726-0280
*	PC EXPO IN CHICAGO	189	801-655-8024
176	PC'S COMPLEAT	206-207	508-624-6400
86	PERSOFT INC	131	800-TCP-3130
192	PERSONAL TEX	236	800-808-7906
206-207	PIKA TECHNOLOGIES	230	613-591-1555
87-88	PINNACLE MICRO	9	714-727-3300
89	PKWARE INC	132	414-354-8699
90	PKWARE INC	187	414-354-8699
174-175	POLYCON GMBH DATA SYSTEMS	227	+49-521-9861322**
115-116	PROXIMA CORP	68	800-447-7694
	Q		
91	QNX SOFTWARE SYSTEMS LTD	17	800-676-0566 ext 1008

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To receive information for an entire category, circle the appropriate number on the adjacent card.

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Accessories/Supplies	1
Add-in Boards	2
Bar Coding	3
Communications/Networking	4
Computer Systems	5
Data Acquisition	6
Diagnostic Equipment	53
Disks & Optical Drives	7
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BYTE

Fill out this coupon carefully. *Please Print.*

Name ______________________ Title ______________________

Company ______________________ Address ______________________

City ______________________ Country ______________________ Code ______________________

Phone ______________________ Fax ______________________

A. My job function is best classified as (check one):
1 ☐ Company Management
2 ☐ IS/MIS/IT Management
3 ☐ Systems Engineering/Integration
4 ☐ Systems/Networking Consulting
5 ☐ Departmental Management (non-IS/MIS)
6 ☐ Technical Services Support
7 ☐ Other (please describe)
____

B. What is your organization's primary business activity at this location (check one):
8 ☐ Business Services (Finance, Banking, Insurance, Healthcare, Professional)
9 ☐ Commerce/Industry (Retail, Wholesale, Construction, Mining, Manufacturing, Transportation)
10 ☐ Reseller/OEM (VAR, VAD, Systems/Network Integrator, Computer Product Manufacturer)
11 ☐ Government (Federal, State, Municipal, Military)
12 ☐ Computer Services (Support, Training, Consulting)
13 ☐ Other (please specify):
____

C. Please indicate which specific fields of interest are important to you so that BYTE may serve you with supplemental information that best meets your needs (select all that apply):
14 ☐ UNIX and Workstations
15 ☐ Networking (LANs, WANs, and Telecommunications)
16 ☐ Multimedia
17 ☐ Reselling/Systems Integration
18 ☐ Applications Development
19 ☐ Other (explain):
____

D. My responsibilities require that I be involved with the following operating system environments (check all that apply):
20 ☐ DOS
21 ☐ OS/2
22 ☐ Mac/OS
23 ☐ UNIX (any, including Solaris)
24 ☐ Windows
25 ☐ Windows/NT
26 ☐ NetWare
27 ☐ Other (please describe):
____

E. The number of employees at my location and company-wide area (check one in each column):

	At My Location	Company-Wide
10,000 or more	28 ☐	33 ☐
5,000 to 9,999	29 ☐	34 ☐
1,000 to 4,999	30 ☐	35 ☐
100 to 999	31 ☐	36 ☐
Under 100	32 ☐	37 ☐

October 1995 90 97 99

Valid until December 31, 1995

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3. Product information will be rushed to you from the selected companies!

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92-93	QUARTERDECK OFFICE SYS	139	310-392-9851
94-95	QUATECH INC	200	800-553-1170
	R		
521-522	RAIMA CORP	48IS 8	206-557-0200
96	RAINBOW TECHNOLOGIES	47	800-852-8569
141	RAVE COMPUTER ASSOCIATES	128	800-966-RAVE
211-212	RCI	231	800-RCI-8090 ext 71
565-566	RECOGNITA (INT'L)	57	+36-1-2018925
194	RHETOREX INC	231	408-370-0881
160-161	ROSE ELECTRONICS	222	800-333-9343
	S		
97-98	SAMTRON DISPLAYS INC (N.A.)	80NA 7	310-537-7000
125-126	SCEPTRE TECHNOLOGIES	155	800-788-2878
242	SCI TRAN PRODUCTS	233	412-367-7063
165	SCITECH INTERNATIONAL	221	800-622-3345
240-241	SERMAX	234	800-209-7126
146	SERVINT CORP (N.A.)	104	800-5SERVINT
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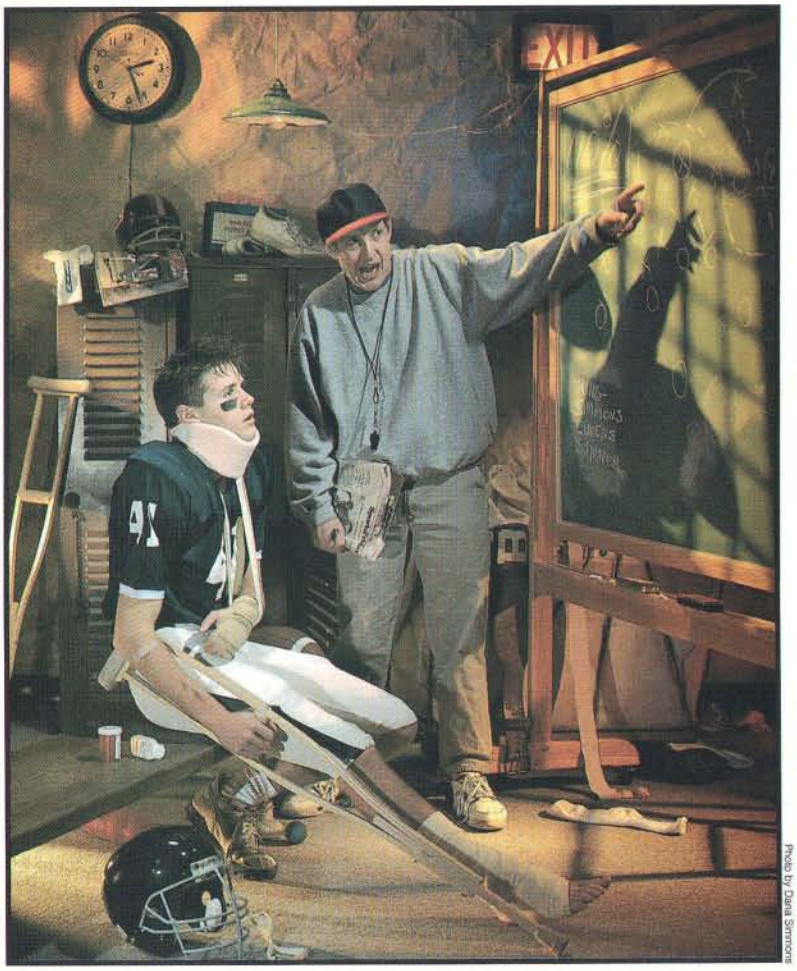

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Ambiguity Machines

Precision, hah! Computers are better at poetry than they are at math.

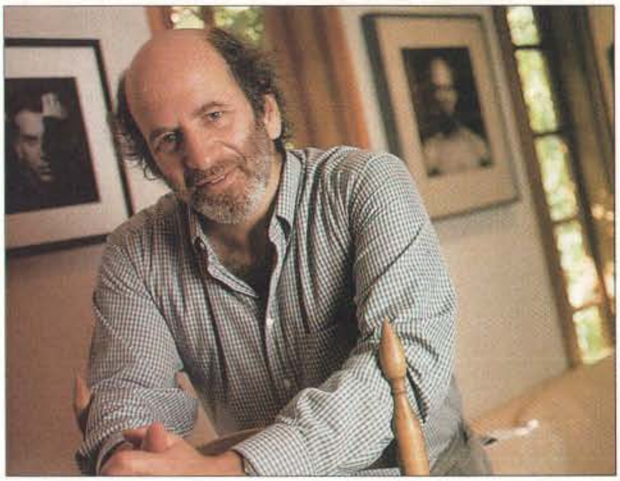
It should not have taken the Pentium math-bug debacle to remind us that computers do not always deliver absolute precision. On the contrary, for all their grounding in mathematical exactitude and their annoying literal-mindedness, computers are really ambiguity-generating machines.

Consider humble E-mail, perhaps the simplest form of computer-mediated communication. At first glance, the difference between a message written on paper and sent through the postal service versus its identically worded electronic counterpart seems insignificant: Both contain the same language, so their meaning is the same—or is it?

One is an artifact of the material world, with intimations of permanence. The other, a captive of cyberspace, can be eliminated in a keystroke. One is evocative—its paper quality, handwriting, and scent all convey nuances of meaning—while the other is framed within the bland uniformity of ASCII. Moreover, it is unlikely that the two messages would use precisely the same words. The tendency in E-mail is toward informality: *Gonna* and *gotta* replace *going to* and *must*. The shift in E-mail is toward oral speech patterns, a rejection of the precision of written discourse in favor of spontaneity.

In publishing, the distinction has starker ramifications. A conventionally printed book may be valued not just for the words inside it but as an object, whose worth is often dictated by such factors as whether it is a first edition, whether its author signed it, or whether a famous person owned it. In contrast, an electronically published book is an entirely different animal. For starters, the idea of copyright is undermined, since the digital book is infinitely reproducible. The notion of authorship is weakened, for the new medium encourages collaboration, often by anonymous contributors. Even the idea of the book itself is threatened, as publishers of electronic scholarly journals have already discovered.

Photography is also rendered fuzzy by digitalization. The malleability of digitized photographs has caused people to look on all photos with deepened skepticism. It is now virtually impossible to tell which images are digitally manipulated. Although photographic trickery has been around for almost as long as the camera, digital technology makes it much easier to doctor an image. Digital art has also broken down the distinction between an "original" and its copies, for all possess the same digital components.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In some digital pursuits, ambiguity is exactly the point. In Multiuser Dimensions, or MUDs, those adolescent computer playgrounds in which players take on imaginary identities while cavorting within a fictional universe, much of the excitement stems from the simple fact that few players know with certainty anything about one another. The player with whom I'm conversing may be a man who presents himself as a woman, a woman presenting herself as a man, or, for that matter, a cleverly designed "bot" that responds to comments in ways that produce the illusion of personhood.

Digital audio raises interesting questions. Composer John Oswald's Plunderphonics, for example, consists of works by musicians ranging from Beethoven to Michael Jackson that Oswald had digitally manipulated in startling and amusing ways. By creating "new" works out of familiar ones, Oswald demonstrated that musical authorship is a surprisingly complex issue, since all music borrows from all the sounds that surround us.

One reason for the rise of computer-generated ambiguity surely is the newness of digital technology. Just as in the early years of electrification and the telephone, we're still trying to figure out what we want computers to do for us, and in the meantime we're confused.

But something else is going on here as well. We like to think of computers as innately masterful at computation (thus, our ridicule for the Pentium when it returns inaccurate results). But we tend to forget that because some number strings are infinitely long, even the most sophisticated computers must settle for numerical approximation—which is to say, imprecision. And imprecision doesn't apply just to computation. While computers' breathtakingly broad impact stems from their capacity to render so much of reality in 0s and 1s, we forget that those combinations of 0s and 1s are all approximations or, put another way, metaphors. Of course, metaphors rightfully dwell in the province of poetry, where they don't mimic reality but use ambiguity to evoke it. ■

Jacques Leslie (jacques@well.com) writes frequently on the social impact of computers. He is the author of The Mark: A War Correspondent's Memoir of Vietnam and Cambodia *(Four Walls Eight Windows, 1995).*

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